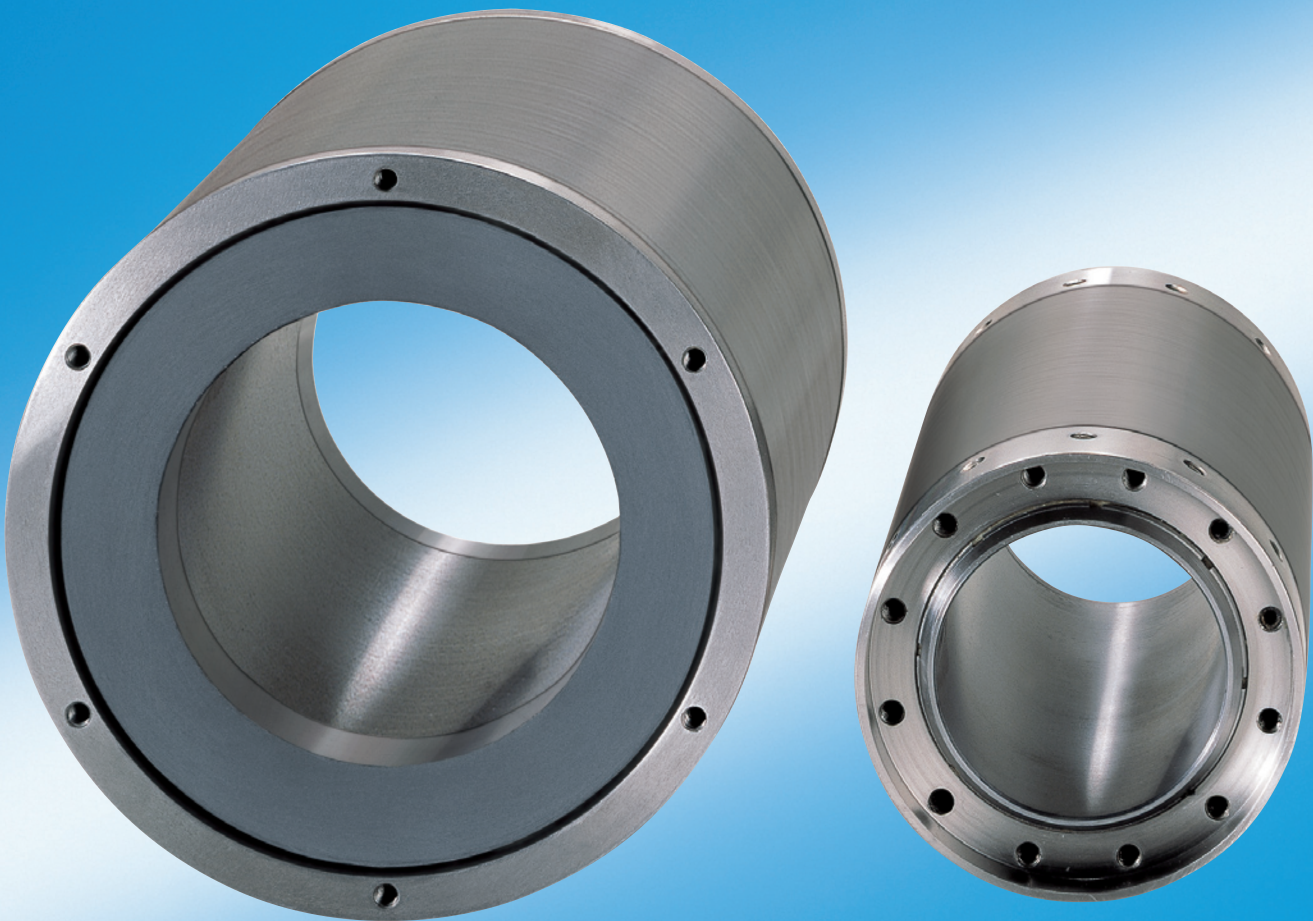
Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth
Bosch Group

Rexroth IndraDyn H Frameless Synchronous Spindle Motors

R911297895
Edition 02

Project Planning Manual



Title Rexroth IndraDyn H
Frameless Synchronous Spindle Motors

Type of Documentation Project Planning Manual

Document Typecode DOK-MOTOR*-MBS-H******-PR02-EN-P

Internal File Refernece
- 29789502_book.doc
- Document Number 120-1500-B327-02/EN

Purpose of Documentation This documentation ....
- explains product features and applications, technical data as well as conditions and limits for operation.
- provides guidelines for product selection, application, handling and operation.

Record of Revisions

Description	Release date	Notes
DOK-MOTOR*-MBS-H******-PR01-EN-P	Sept04	1st edition
DOK-MOTOR*-MBS-H******-PR02-EN-P	May05	1st reprint

Validity The specified data is for product description purposes only and may not be deemed to be guaranteed unless expressly confirmed in the contract. All rights are reserved with respect to the content of this documentation and the availability of the product.

Published by Bosch Rexroth AG
Bgm.-Dr.-Nebel-Str. 2 • D-97816 Lohr a. Main

Telefon +49 (0)93 52 / 40-0 • Tx 68 94 21 • Fax +49 (0)93 52 / 40-48 85

http://www.boschrexroth.com/

Abt. BRC/EDM1 (FS)

Note This document has been printed on chlorine-free bleached paper.

Table of Contents

1 Introduction to the Product

New technologies with high economic benefits are posing increasingly extreme demands on the acceleration, velocity and precision of motors.

Rexroth IndraDyn H motors are state-of-the-art, high-speed synchronous frameless motors, optimized for high torques at high speeds. They consist of a stator with a three-phase winding and a rotor with permanent magnets.

Due to a wide constant-power range, the brief startup times and the low rotor temperature, these motors are especially suitable for use in motor spindles.

The novel cooling system, which is self-contained in the motor, reduces expenses for the machine manufacturer and increases the cooling efficiency and capacity.

IndradynH-Stat_Rot.tif

Fig. 1-1: Examples of IndraDyn H stator and rotor

Rexroth IndraDyn H motors are used mainly as direct drives in motor spindles. The position of the motor between the main spindle bearings gives the motor spindle a high rigidity. As a result, the main spindle and the C axis can be operated with only one drive in grinding machines, for example.

Motor spindles are used for turning, milling and grinding in machine tools, transfer lines, processing centers and special-purpose machines.

Performance list The following diagram gives an overview of the performance range of the IndraDyn H motors.

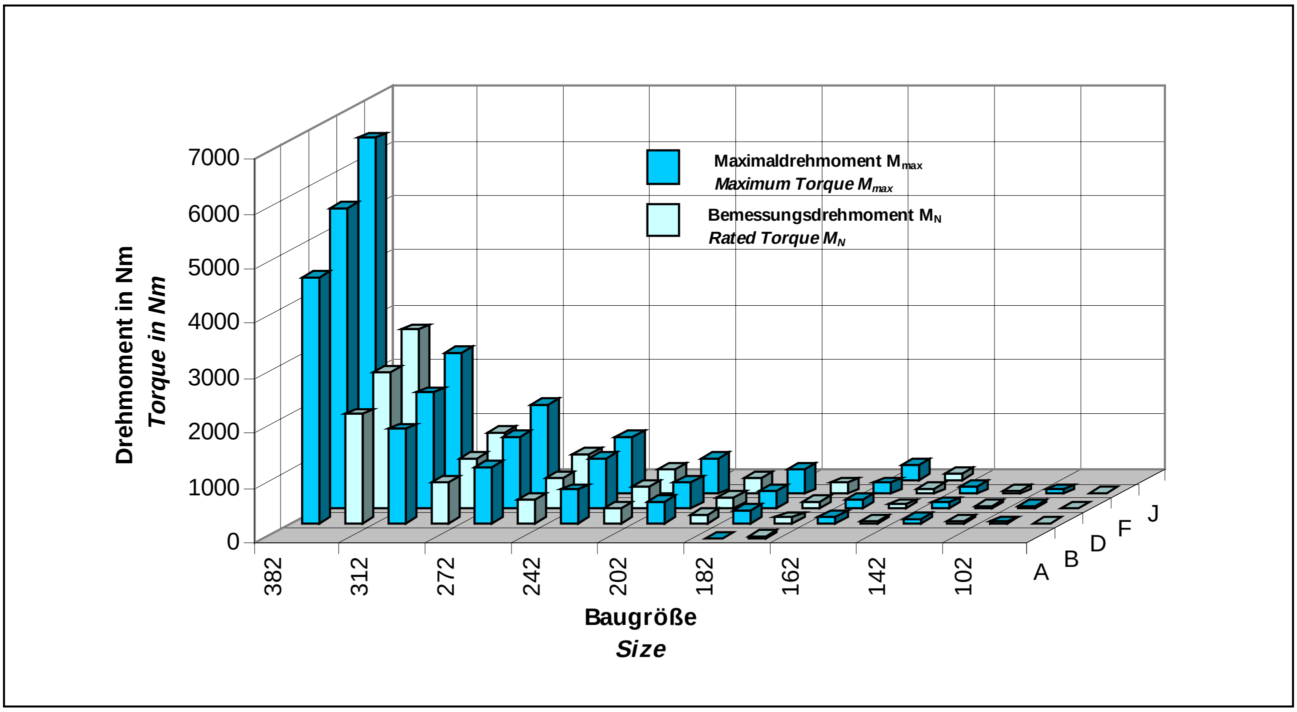


Fig. 1-2: IndraDyn H performance range

About this Documentation

Document structure

This documentation includes safety instructions, technical data and operating instructions. The following setup provides an overview of the contents of this documentation.

Chapter	Title	Content	
1	Introduction	Introduction to the product and notes	
2	Important instructions on use	**Important safety instructions**	
3	Safety		
4	Technical data	Product description	For planners and projectors
5	Dimension sheets		
6	Type code		
7	Accessories		
8	Connection techniques		
9	Notes on application	Practice	For operating and maintenance personnel
10	Handling & transport		
11	Installation		
12	Operation		
13	Service & support		
14	Index	Additional information	

Fig. 1-3: Chapter structure

Supplementary Documentation

To design the IndraDyn H motor type drive systems, you may need additional documentation depending on the devices used. Rexroth provides all product documentation on CD in PDF format. To design a system, you will not need all the documentation included on the CD.

Note: All documentation on the CD is also available in a printed version. You can order the required product documentation from your Rexroth sales office.

Material No.	Title / description
R911281882	-Product documentation Electric Drives and Controls Version **xx** 1) DOK-GENRL-CONTR*DRIVE-GN**xx**-**DE**-D650
R911281883	-Product documentation Electric Drives and Controls Version **xx** 1) DOK-GENRL-CONTR*DRIVE-GN**xx**-**EN**-D650
1) The index (e.g. ..**02**-...) identifies the version of the CD.	

Fig. 1-4: Supplementary documentation

Additional Components

Documentation for external systems which are connected to BOSCH REXROTH components are not included in the scope of delivery and must be ordered directly from the corresponding manufacturers.

For information on the manufacturers, see chapter 9 "Notes on Application".

Feedback

Your experiences are an essential part of the process of improving both the product and the documentation.

Please do not hesitate to inform us of any mistakes you detect in this documentation or of any modifications you might desire. We would appreciate your feedback.

Please send your remarks to:

REXROTH INDRAMAT GmbH
Dep. BRC/EDM1
Bürgermeister-Dr.-Nebel-Strasse 2
D-97816 Lohr, Germany

Fax +49 (0) 93 52 / 40-43 80

Standards

This documentation refers to German, European and international technical standards. Documents and sheets on standards are subject to copyright protection and may not be passed on to third parties by REXROTH INDRAMAT. If necessary, please address the authorized sales offices or, in Germany, directly to:

BEUTH Verlag GmbH
Burggrafenstrasse 6
10787 Berlin

Phone +49-(0)30-26 01-22 60, Fax +49-(0)30-26 01-12 60
Internet: http://www.din.de/beuthEmail: postmaster@beuth.de

2 Safety Instructions for Electric Drives and Controls

2.1 Introduction

Read these instructions before the initial startup of the equipment in order to eliminate the risk of bodily harm or material damage. Follow these safety instructions at all times.

Do not attempt to install or start up this equipment without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation of the equipment prior to working with the equipment at any time. If you do not have the user documentation for your equipment, contact your local Bosch Rexroth representative to send this documentation immediately to the person or persons responsible for the safe operation of this equipment.

If the equipment is resold, rented or transferred or passed on to others, then these safety instructions must be delivered with the equipment.

WARNING

Improper use of this equipment, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!

2.2 Explanations

The safety instructions describe the following degrees of hazard seriousness in compliance with ANSI Z535. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions.

Warning symbol with signal word	Degree of hazard seriousness according to ANSI
DANGER	Death or severe bodily harm will occur.
WARNING	Death or severe bodily harm may occur.
CAUTION	Bodily harm or material damage may occur.

Fig. 2-1: Hazard classification (according to ANSI Z535)

2.3 Hazards by Improper Use

DANGER

High voltage and high discharge current! Danger to life or severe bodily harm by electric shock!

DANGER

Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!

WARNING

High electrical voltage due to wrong connections! Danger to life or bodily harm by electric shock!

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

CAUTION

Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!

CAUTION

Risk of injury due to improper handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock or incorrect handling of pressurized systems!

CAUTION

Risk of injury due to incorrect handling of batteries!

2.4 General Information

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before starting up the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this equipment.
- Only persons who are trained and qualified for the use and operation of the equipment may work on this equipment or within its proximity.
  - The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the equipment as well as an understanding of all warnings and precautionary measures noted in these instructions.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and equipment on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.
- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The equipment is designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Use only safety features and applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded.
  The following areas of use and application, for example, include safety features and applications: construction cranes, elevators used for people or freight, devices and vehicles to transport people, medical applications, refinery plants, transport of hazardous goods, nuclear applications, applications in which electrical devices with vital functions can be electromagnetically disturbed, mining, food processing, control of protection equipment (also in a machine).
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.
  The machine and installation manufacturer must
  - make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components,
  - make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Startup of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.

- Operation is only permitted if the national EMC regulations for the application are met.
  The instructions for installation in accordance with EMC requirements can be found in the documentation "EMC in Drive and Control Systems".
  The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
- Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.

2.5 Protection Against Contact with Electrical Parts

Note: This section refers to equipment and drive components with voltages above 50 Volts.

Touching live parts with voltages of 50 Volts and more with bare hands or conductive tools or touching ungrounded housings can be dangerous and cause electric shock. In order to operate electrical equipment, certain parts must unavoidably have dangerous voltages applied to them.

DANGER

High electrical voltage! Danger to life, severe bodily harm by electric shock!

⇒ Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain or repair this equipment.

⇒ Follow general construction and safety regulations when working on high voltage installations.

⇒ Before switching on power the ground wire must be permanently connected to all electrical units according to the connection diagram.

⇒ Do not operate electrical equipment at any time, even for brief measurements or tests, if the ground wire is not permanently connected to the points of the components provided for this purpose.

⇒ Before working with electrical parts with voltage higher than 50 V, the equipment must be disconnected from the mains voltage or power supply. Make sure the equipment cannot be switched on again unintended.

⇒ The following should be observed with electrical drive and filter components:

⇒ Wait thirty (30) minutes after switching off power to allow capacitors to discharge before beginning to work. Measure the voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.

⇒ Never touch the electrical connection points of a component while power is turned on.

⇒ Install the covers and guards provided with the equipment properly before switching the equipment on. Prevent contact with live parts at any time.

⇒ A residual-current-operated protective device (RCD) must not be used on electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device.

⇒ Electrical components with exposed live parts and uncovered high voltage terminals must be installed in a protective housing, for example, in a control cabinet.

To be observed with electrical drive and filter components:

DANGER

High electrical voltage on the housing!
High leakage current! Danger to life, danger of injury by electric shock!

⇒ Connect the electrical equipment, the housings of all electrical units and motors permanently with the safety conductor at the ground points before power is switched on. Look at the connection diagram. This is even necessary for brief tests.

⇒ Connect the safety conductor of the electrical equipment always permanently and firmly to the supply mains. Leakage current exceeds 3.5 mA in normal operation.

⇒ Use a copper conductor with at least 10 mm² cross section over its entire course for this safety conductor connection!

⇒ Prior to startups, even for brief tests, always connect the protective conductor or connect with ground wire. Otherwise, high voltages can occur on the housing that lead to electric shock.

2.6 Protection Against Electric Shock by Protective Low Voltage (PELV)

All connections and terminals with voltages between 0 and 50 Volts on Rexroth products are protective low voltages designed in accordance with international standards on electrical safety.

WARNING

High electrical voltage due to wrong connections! Danger to life, bodily harm by electric shock!

⇒ Only connect equipment, electrical components and cables of the protective low voltage type (PELV = Protective Extra Low Voltage) to all terminals and clamps with voltages of 0 to 50 Volts.

⇒ Only electrical circuits may be connected which are safely isolated against high voltage circuits. Safe isolation is achieved, for example, with an isolating transformer, an opto-electronic coupler or when battery-operated.

2.7 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of the connected motors. Some common examples are:

- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily injury and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

DANGER

Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

⇒ Ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. Unintended machine motion is possible if monitoring devices are disabled, bypassed or not activated.

⇒ Pay attention to unintended machine motion or other malfunction in any mode of operation.

⇒ Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:

- use safety fences
- use safety guards
- use protective coverings
- install light curtains or light barriers

⇒ Fences and coverings must be strong enough to resist maximum possible momentum, especially if there is a possibility of loose parts flying off.

⇒ Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before startup. Don't operate the machine if the emergency stop is not working.

⇒ Isolate the drive power connection by means of an emergency stop circuit or use a starting lockout to prevent unintentional start.

⇒ Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone. Safe standstill can be achieved by switching off the power supply contactor or by safe mechanical locking of moving parts.

⇒ Secure vertical axes against falling or dropping after switching off the motor power by, for example:

- mechanically securing the vertical axes
- adding an external braking/ arrester/ clamping mechanism
- ensuring sufficient equilibration of the vertical axes

The standard equipment motor brake or an external brake controlled directly by the drive controller are not sufficient to guarantee personal safety!

⇒ Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:

- maintenance and repair work
- cleaning of equipment
- long periods of discontinued equipment use

⇒ Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such equipment cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

2.8 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated near current-carrying conductors and permanent magnets in motors represent a serious health hazard to persons with heart pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

⇒ Persons with heart pacemakers, hearing aids and metal implants are not permitted to enter the following areas:

- Areas in which electrical equipment and parts are mounted, being operated or started up.
- Areas in which parts of motors with permanent magnets are being stored, operated, repaired or mounted.

⇒ If it is necessary for a person with a heart pacemaker to enter such an area, then a doctor must be consulted prior to doing so. Heart pacemakers that are already implanted or will be implanted in the future, have a considerable variation in their electrical noise immunity. Therefore there are no rules with general validity.

⇒ Persons with hearing aids, metal implants or metal pieces must consult a doctor before they enter the areas described above. Otherwise, health hazards will occur.

2.9 Protection Against Contact with Hot Parts

CAUTION

Housing surfaces could be extremely hot! Danger of injury! Danger of burns!

⇒ Do not touch housing surfaces near sources of heat! Danger of burns!

⇒ After switching the equipment off, wait at least ten (10) minutes to allow it to cool down before touching it.

⇒ Do not touch hot parts of the equipment, such as housings with integrated heat sinks and resistors. Danger of burns!

2.10 Protection During Handling and Mounting

Under certain conditions, incorrect handling and mounting of parts and components may cause injuries.

CAUTION

Risk of injury by incorrect handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock!

⇒ Observe general installation and safety instructions with regard to handling and mounting.

⇒ Use appropriate mounting and transport equipment.

⇒ Take precautions to avoid pinching and crushing.

⇒ Use only appropriate tools. If specified by the product documentation, special tools must be used.

⇒ Use lifting devices and tools correctly and safely.

⇒ For safe protection wear appropriate protective clothing, e.g. safety glasses, safety shoes and safety gloves.

⇒ Never stand under suspended loads.

⇒ Clean up liquids from the floor immediately to prevent slipping.

2.11 Battery Safety

Batteries contain reactive chemicals in a solid housing. Inappropriate handling may result in injuries or material damage.

⚠ CAUTION

Risk of injury by incorrect handling!

⇒ Do not attempt to reactivate discharged batteries by heating or other methods (danger of explosion and cauterization).

⇒ Never charge non-chargeable batteries (danger of leakage and explosion).

⇒ Never throw batteries into a fire.

⇒ Do not dismantle batteries.

⇒ Do not damage electrical components installed in the equipment.

Note: Be aware of environmental protection and disposal! The batteries contained in the product should be considered as hazardous material for land, air and sea transport in the sense of the legal requirements (danger of explosion). Dispose batteries separately from other waste. Observe the legal requirements in the country of installation.

2.12 Protection Against Pressurized Systems

Certain motors and drive controllers, corresponding to the information in the respective Project Planning Manual, must be provided with pressurized media, such as compressed air, hydraulic oil, cooling fluid and cooling lubricant supplied by external systems. Incorrect handling of the supply and connections of pressurized systems can lead to injuries or accidents. In these cases, improper handling of external supply systems, supply lines or connections can cause injuries or material damage.

⚠ CAUTION

Danger of injury by incorrect handling of pressurized systems !

⇒ Do not attempt to disassemble, to open or to cut a pressurized system (danger of explosion).

⇒ Observe the operation instructions of the respective manufacturer.

⇒ Before disassembling pressurized systems, release pressure and drain off the fluid or gas.

⇒ Use suitable protective clothing (for example safety glasses, safety shoes and safety gloves)

⇒ Remove any fluid that has leaked out onto the floor immediately.

Note: Environmental protection and disposal! The media used in the operation of the pressurized system equipment may not be environmentally compatible. Media that are damaging the environment must be disposed separately from normal waste. Observe the legal requirements in the country of installation.

Notes

3 Important directions for use

3.1 Appropriate use

Introduction

Bosch Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Note: Bosch Rexroth, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Bosch Rexroth products, make sure that all the pre-requisites for appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

Areas of use and application

High-speed synchronous frameless motors of the IndraDyn H line made by Bosch Rexroth are designed to be used as rotary main motors.

Typical applications are in:

- machine tools

Several types of motors with differing drive power and different interfaces are available for application-specific uses.

Control and monitoring of the motors may require additional sensors and actors.

Note: The motors may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines.

Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

Every drive controller has to be programmed before starting it up, making it possible for the motor to execute the specific functions of an application.

The motors may only be operated under the assembly, installation and ambient conditions as described here (temperature, protection categories, humidity, EMC requirements, etc.) and in the position specified.

3.2 Inappropriate use

Inappropriate use is defined as using the motors outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified.

IndraDyn H motors may not be used if

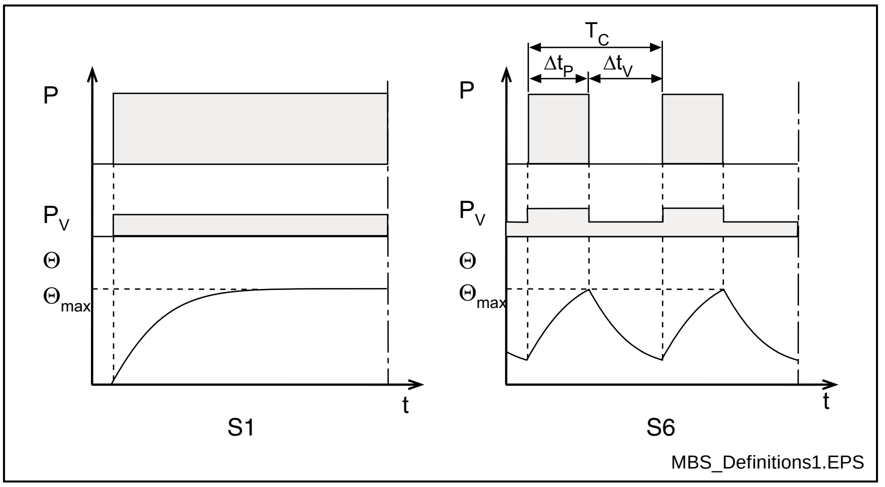
- they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extremely high maximum temperatures or if
- Bosch Rexroth has not specifically released them for that intended purpose. Please note the specifications outlined in the general Safety Instructions!

4 Technical Data

4.1 Definitions

Operating Modes

Bosch Rexroth motors are documented according to the test criteria and measuring methods of EN 60034-1. The stated technical data refer to the operating mode S1 (continuous operation) and S6 (periodic operation), each with liquid cooling with water as the cooling medium.



P:	Capacity
P_V:	Electric losses
Θ:	Temperature
$Θ_{max}$:	Highest temperature (stator)
t:	Time
T_C:	Cycle time
$Δt_P$:	Operating time with constant load
$Δt_V$:	Idle time

Fig. 4-1: Operating modes according to EN 60034-1 :1998

ON Time

The operating mode S6 is supplemented by specification of the duty cycle (ED) in %. The duty cycle is calculated as follows:

$$ED = \frac{\Delta t_P}{T_C} \cdot 100\%$$

ED:	Duty cycle in %
T_C:	Cycle time
$Δt_P$:	On time

Fig. 4-2: Duty cycle

Parameters

Rated torque Available torque that can be output at the rated speed in operating mode S1 (continuous operation). Unit Newton meter (Nm).

Rated speed Typical working speed as defined by the manufacturer. Depending on the particular application, other working speeds are possible (see speed-torque characteristic curve).

Rated power Mechanical power output of the motor while running at rated speed and rated torque. The value is specified in kilowatts (kW).

Rated current Phase current of the motor while running at rated speed and rated torque. The value is specified as root-mean-square value in amps (A).

Maximum torque This is the maximum torque available using maximum current I_{max} . The achievable maximum torque depends on the drive controller used.

Maximum current This is the maximum current (root-mean-square) of the motor at M_{max}. The value is specified in amps (A).

Rotor moment of inertia J_{rot} The moment of inertia of the rotor without bearings and encoder. Unit: kgm^2.

Torque constant at 20 C K_{M_nenn} This is the relation of torque increase to the motor phase-current (RMS). The value is specified in Nm/A. Valid up to the rated current I_{nenn}.

Voltage constant at 20°C K_{EMK_1000} Root-mean-square of the induced motor voltage with respect to the motor speed. The value is specified in V/1000 rpm.

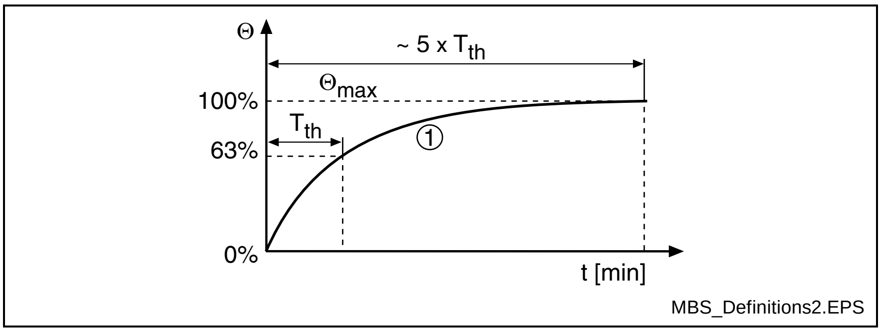
Winding resistance at 20°C R_{12} Winding resistance measured between two phases in ohms (Ω).

Stator/Rotor mass m_{stat} / m_{rot} The mass of stator and rotor, without bearing and encoder, stated in kilogram (kg).

Maximum speed n_{max} Maximum allowable speed of the motor in n_{max}. Value specified in RPM. Normally restricted by mechanical factors like centrifugal force or bearing stress.

Number of pole pairs p Number of pole pairs of the motor.

Thermal time constant T_{th} The time it takes for the motor temperature to rise to 63% of the final temperature with the stators loaded with rated torque in S1-operation and liquid cooling.

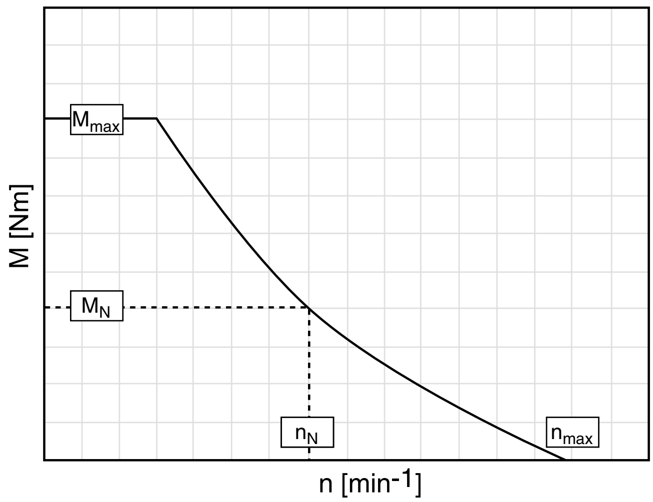


(1): Curve of the stator temperature over time
T_{th}: Thermal time constant

Fig. 4-3: Thermal time constant

Operating characteristic

The following sample characteristic curves explain the operating behavior of IndraDyn H motors, as does information found in the motor data sheet.



[1]: Rated torque M_{nenn} [2]: Rated speed n_{nenn}
[3]: Maximum torque M_{max} [4]: Max. speed with max. torque n_{Mmax}
[5]: Max. speed n_{max}

Fig. 4-4: Example motor characteristic curve

Note: The attainable motor torque depends on the drive device used: it is available for IndraDyn H motors only if the drive controller is able to set the input control angle optimally. This is the case for all IndraDrive devices of Bosch Rexroth.

If the drive controller is not able to do this, the reluctance torque cannot be used, and 10-15% less rated torque will be available.

The maximum torque M_{max} is available up to the speed n_{Mmax}. When the velocity rises, the available DC bus voltage is reduced by the velocity-dependent back-EMF (electromotive force) of the motor. This leads to a reduction of the maximum torque with rising velocity.

The specified characteristic curves can be linearly extrapolated to the existing voltages if the connection voltages or mains voltages are different.

Example:

$$n_{(U_{DC},neu)} = \frac{U_{DC,neu}}{540V} \cdot n_{nenn}$$

Fig. 4-5: Example for conversion

Conversion to DC bus voltage $750V_{DC}$

$$M_{max\ 750V} = M_{max} = \text{constant} \qquad M_{nenn\ 750V} = M_{nenn} = \text{constant}$$

$$n_{max\ 750V} = \frac{750V}{540V} \cdot n_{max} \qquad n_{nenn\ 750V} = \frac{750V}{540V} \cdot n_{nenn}$$

Fig. 4-6: Conversion-example to DC bus voltage $750V_{DC}$

4.2 Data Sheet Size 102 (preliminary)

Description		Symbol	Unit	Size 102		
Motor data [1]						
Frame length				B	D	F
Winding code				0800		
Rated torque		M_{nenn}	Nm	12	20	33
Rated speed		n_{nenn}	rpm	8000		
Rated power		P_{nenn}	KW	10,1	16,8	27,6
Rated current		I_{nenn}	A	18	24	39
Maximum torque [2]		M_{max}	Nm	30	45	75
Maximum current		I_{max}	A	48	69	100
Maximum speed		n_{max}	rpm	30000		
Minimum cross-section power cable [3]		A	mm²	2,5	4	10
Moment of inertia for rotor type 1N [6]		J_{rot}	kgm²	0,003	0,004	0,006
Moment of inertia for rotor type 2N [7]				i.V.	i.V.	i.V.
Torque constant at 20°C		K_{M_nenn}	Nm/A	i.p.	i.p.	i.p.
Constant voltage at 20°C [4]		K_{EMK_1000}	V/ rpm	i.p.	i.p.	i.p.
Winding resistance at 20°C		R12	Ohm	i.p.	i.p.	i.p.
Winding inductivity	longitudinal	L_d	mH	i.p.	i.p.	i.p.
	across	L_q	mH	i.p.	i.p.	i.p.
Thermal time constant		T_{th}	min	i.p.	i.p.	i.p.
Mass	Rotor [6]	m_{rot}	kg	2,1	3,1	5,1
	Stator	m_{stat}	kg	7,7	10,1	14,9
Permissible ambient temperature		T_{um}	°C	0...+40		
Permissible storage and transport temperature		T_{lager}	°C	-20...+80		
Insulation class				F		
International protection class acc. to IEC60050-411				IP00		
Number of pole pairs		p		3		
Liquid Cooling						
Rated power loss		P_{V_H2O}	kW	i.p.	i.p.	i.p.
Coolant inlet temperature [5]		T_{ein}	°C	+10...+40		
Coolant temperature rise at P_V [5]		ΔT_{diff}	K	10		
Necessary coolant flow for ΔT_{diff} [5]		Q_{min_H2O}	l/min	i.p.	i.p.	i.p.
Pressure drop at Q_{min}		Δp_{diff}	bar	i.p.	i.p.	i.p.
Permissible inlet pressure		p_{max}	bar	5		
Volume liquid cooling duct		V_{kuehl}	l	0,018	0,024	0,035

i.p. in preparation
1) The determined values are root-mean-squares according to IEC 60034-1, if no others are given. Reference value 540 V_{DC}
2) The achievable maximum torque depends on the drive controller used.
3) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross sections may be necessary.
For notes regarding connection cables on the motor see chapter 8.2
EMV = electromagnetic force Root-mean-square applying to 1000 min^{-1}.
The data refer to operation with liquid cooling, cooling medium water.
For additional notes for coolant inlet temperature see chapter 9.5
6) Values for rotor design “1N” with bigger available rotor internal diameter
7) Values for rotor design “2N” with bigger available rotor internal diameter

Fig. 4-7: Technical Data Size 102 (preliminary)

4.3 Data Sheet Size 142 (preliminary)

Description		Symbol	Unit	Size 142		
Motor data [1]						
Frame length				B	D	F
Winding code				0700		
Rated torque		M_{nenn}	Nm	35	50	65
Rated speed		n_{nenn}	rpm	7000		
Rated power		P_{nenn}	KW	25,7	36,7	47,6
Rated current		I_{nenn}	A	38	55	68
Maximum torque [2]		M_{max}	Nm	80	115	150
Maximum current		I_{max}	A	100	145	180
Maximum speed		n_{max}	rpm	28000		
Minimum cross-section power cable [3]		A	mm²	10	16	16
Moment of inertia for rotor type 1N [6]		J_{rot}	kgm²	0,011	0,014	0,017
Moment of inertia for rotor type 2N [7]		J_{rot}	kgm²	i.V.	i.V.	i.V.
Torque constant at 20°C		K_{M_nenn}	Nm/A	i.p.	i.p.	i.p.
Constant voltage at 20°C [4]		K_{EMK_1000}	V/ rpm	i.p.	i.p.	i.p.
Winding resistance at 20°C		R12	Ohm	i.p.	i.p.	i.p.
Winding inductivity	longitudinal	L_d	mH	i.p.	i.p.	i.p.
	across	L_q	mH	i.p.	i.p.	i.p.
Thermal time constant		T_{th}	min	i.p.	i.p.	i.p.
Mass	Rotor [6]	m_{rot}	kg	4,6	6,5	8,3
	Stator	m_{stat}	kg	16,7	21,2	25,7
Permissible ambient temperature		T_{um}	°C	0...+40		
Permissible storage and transport temperature		T_{lager}	°C	-20...+80		
Insulation class				F		
International protection class acc. to IEC60050-411				IP00		
Number of pole pairs		p		4		
Liquid Cooling						
Rated power loss		P_{V_H2O}	kW	i.p.	i.p.	i.p.
Coolant inlet temperature [5]		T_{ein}	°C	+10...+40		
Coolant temperature rise at P_V [5]		ΔT_{diff}	K	10		
Necessary coolant flow for ΔT_{diff} [5]		Q_{min_H2O}	l/min	i.p.	i.p.	i.p.
Pressure drop at Q_{min}		Δp_{diff}	bar	i.p.	i.p.	i.p.
Permissible inlet pressure		p_{max}	bar	5		
Volume liquid cooling duct		V_{kuehl}	l	0,028	0,036	0,043

1) The determined values are root-mean-squares according to IEC 60034-1, if no others are given. Reference value 540 V_{DC}
2) The achievable maximum torque depends on the drive controller used.
3) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross sections may be necessary.
For notes regarding connection cables on the motor see chapter 8.2
EMV = electromagnetic force Root-mean-square applying to 1000 min^{-1}.
The data refer to operation with liquid cooling, cooling medium water.
For additional notes for coolant inlet temperature see chapter 9.5
6) Values for rotor design “1N” with bigger available rotor internal diameter
7) Values for rotor design “2N” with bigger available rotor internal diameter

Fig. 4-8: Technical Data Size 142 (preliminary)

4.4 Data Sheet Size 162

Description		Symbol	Unit	Size 162			
Motor data [1]							
Frame length				B	D	F	J
Winding code				0400	0400	0310	0200
Rated torque		M_{nenn}	Nm	50	70	90	120
Rated speed		n_{nenn}	rpm	4000	4000	3100	2000
Rated power		P_{nenn}	KW	20,9	29,3	29,2	25,1
Rated current		I_{nenn}	A	42	64	64	64
Maximum torque [2]		M_{max}	Nm	115	160	200	275
Maximum current		I_{max}	A	110	170	170	170
Maximum speed		n_{max}	rpm	16000	16000	12400	8000
Minimum cross-section power cable [3]		A	mm²	10	16	16	16
Moment of inertia for rotor type 1N [6]		J_{rot}	kgm²	0,014	0,018	0,022	0,028
Moment of inertia for rotor type 2N [7]				0,016	0,02	0,024	0,03
Torque constant at 20°C		K_{M_nenn}	Nm/A	1,24	1,09	1,406	1,875
Constant voltage at 20°C [4]		K_{EMK_1000}	V/ rpm	90	90	110	160
Winding resistance at 20°C		R12	Ohm	0,24	0,15	0,18	0,46
Winding inductivity	longitudinal	L_d	mH	1,04	1,04	1,1	2
	across	L_q	mH	3,12	2,685	3,28	5,8
Thermal time constant		T_{th}	min	i.p.	i.p.	i.p.	i.p.
Mass	Rotor [6]	m_{rot}	kg	6,9	8,8	10,6	13,4
	Stator	m_{stat}	kg	22,0	28,1	34,1	46,1
Permissible ambient temperature		T_{um}	°C	0...+40			
Permissible storage and transport temperature		T_{lager}	°C	-20...+80			
Insulation class				F			
International protection class acc. to IEC60050-411				IP00			
Number of pole pairs		p		4			
Liquid Cooling							
Rated power loss		P_{V_H2O}	kW	0,55	0,9	1,1	1,5
Coolant inlet temperature [5]		T_{ein}	°C	+10...+40			
Coolant temperature rise at P_V [5]		ΔT_{diff}	K	10			
Necessary coolant flow for ΔT_{diff} [5]		Q_{min_H2O}	l/min	2	3	3	4
Pressure drop at Q_{min}		Δp_{diff}	bar	1,6			
Permissible inlet pressure		p_{max}	bar	5			
Volume liquid cooling duct		V_{kuehl}	l	0,056	0,071	0,086	0,109

i.p. = in preparation
1) The determined values are root-mean-squares according to IEC 60034-1, if no others are given. Reference value 540 V_{DC}
2) The achievable maximum torque depends on the drive controller used.
3) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross sections may be necessary.
For notes regarding connection cables on the motor see chapter 8.2
EMV = electromagnetic force Root-mean-square applying to 1000 min^{-1}.
The data refer to operation with liquid cooling, cooling medium water.
For additional notes for coolant inlet temperature see chapter 9.5
6) Values for rotor design "1N" with bigger available rotor internal diameter
7) Values for rotor design "2N" with bigger available rotor internal diameter

Fig. 4-9: Technical Data Size 162

4.5 Data Sheet Size 182

Description	Symbol	Unit	Size 182				
Motor data [1]							
Frame length			A		B	D	F
Winding code			0100	0250	0280	0260	0200
Rated torque	M_{nenn}	Nm	12		100	140	200
Rated speed	n_{nenn}	rpm	1000	2500	2800	2600	2000
Rated power	P_{nenn}	KW	1,25	3,1	29,3	38,1	41,9
Rated current	I_{nenn}	A	3,7	10,6	64	71	71
Maximum torque [2]	M_{max}	Nm	30		230	320	450
Maximum current	I_{max}	A	11	32	170	200	200
Maximum speed	n_{max}	rpm	4000	10000	11200	10400	8000
Minimum cross-section power cable [3]	A	mm²	1	1	16	16	16
Moment of inertia for rotor type 1N [6]	J_{rot}	kgm²	0,0089		0,031	0,039	0,053
Moment of inertia for rotor type 2N [7]	J_{rot}	kgm²	0,0099		0,035	0,043	0,059
Torque constant at 20°C	K_{M_nenn}	Nm/A	3,51	1,132	1,56	1,97	2,82
Constant voltage at 20°C [4]	K_{EMK_1000}	V/ rpm	297	141	113	130	160
Winding resistance at 20°C	R12	Ohm	15,47	3,89	0,17	0,15	0,21
Winding inductivity longitudinal	L_d	mH	56,34	9	1	1	1,1
Winding inductivity across	L_q	mH	127,9	25	3,6	2,6	3,7
Thermal time constant	T_{th}	min	9,4	9,4	i.p.	i.p.	i.p.
Mass Rotor [6]	m_{rot}	kg	2,7		9,6	11,8	21,3
Mass Stator	m_{stat}	kg	6,9		32,1	38,9	52,6
Permissible ambient temperature	T_{um}	°C	0...+40				
Permissible storage and transport temperature	T_{lager}	°C	-20...+80				
Insulation class			F				
International protection class acc. to IEC60050-411			IP00				
Number of pole pairs	p		4				
Liquid Cooling							
Rated power loss	P_{V_H2O}	kW	0,27		1,05	1,1	1,5
Coolant inlet temperature [5]	T_{ein}	°C	+10...+40				
Coolant temperature rise at P_V [5]	ΔT_{diff}	K	10				
Necessary coolant flow for ΔT_{diff} [5]	Q_{min_H2O}	l/min	3		3	3	4
Pressure drop at Q_{min}	Δp_{diff}	bar	0,36		1,6	1,6	1,6
Permissible inlet pressure	p_{max}	bar	5				
Volume liquid cooling duct	V_{kuehl}	l	0,019		0,065	0,08	0,11

i.p. = in preparation
[1] The determined values are root-mean-squares according to IEC 60034-1, if no others are given. Reference value 540 V_{DC}
[2] The achievable maximum torque depends on the drive controller used.
[3] Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross sections may be necessary.
For notes regarding connection cables on the motor see chapter 8.2
EMV = electromagnetic force Root-mean-square applying to 1000 min^{-1}.
The data refer to operation with liquid cooling, cooling medium water.
For additional notes for coolant inlet temperature see chapter 9.5
[6] Values for rotor design "1N" with bigger available rotor internal diameter
[7] Values for rotor design "2N" with bigger available rotor internal diameter

Fig. 4-10: Technical Data Size 182

4.6 Data Sheet Size 202

Description	Symbol	Unit	Size 202				
Motor data [1]							
Frame length			A	B		D	F
Winding code			0200	0150	0210	0170	0120
Rated torque	M_{nenn}	Nm	120	170		210	290
Rated speed	n_{nenn}	rpm	2000	1500	2100	1700	1200
Rated power	P_{nenn}	KW	25,1	26,7	37,4	37,4	36,4
Rated current	I_{nenn}	A	48	52	68	68	68
Maximum torque [2]	M_{max}	Nm	270	390	390	480	650
Maximum current	I_{max}	A	125	141	180	180	180
Maximum speed	n_{max}	rpm	8000	6000	8400	6800	4800
Minimum cross-section power cable [3]	A	mm²	10	10	16	16	16
Moment of inertia for rotor type 1N [6]	J_{rot}	kgm²	0,05	0,064		0,077	0,104
Moment of inertia for rotor type 2N [7]			0,055	0,07		0,084	0,114
Torque constant at 20°C	K_{M_nenn}	Nm/A	2,5	3,27	2,5	3,09	4,26
Constant voltage at 20°C [4]	K_{EMK_1000}	V/ rpm	160	250	170	185	260
Winding resistance at 20°C	R12	Ohm	0,5	0,38	0,19	0,23	0,31
Winding inductivity – longitudinal	L_d	mH	1,3	2,2	1,1	1,5	1,3
Winding inductivity – across	L_q	mH	5,1	6,6	3,2	4,4	3,6
Thermal time constant	T_{th}	min	i.p.	i.p.	i.p.	i.p.	i.p.
Mass – Rotor [6]	m_{rot}	kg	12,8	16,2		19,6	26,9
Mass – Stator	m_{stat}	kg	33,0	40,7		48,3	63,7
Permissible ambient temperature	T_{um}	°C	0...+40				
Permissible storage and transport temperature	T_{lager}	°C	-20...+80				
Insulation class			F				
International protection class acc. to IEC60050-411			IP00				
Number of pole pairs	p		5				
Liquid Cooling							
Rated power loss	P_{V_H2O}	kW	1,05	1,3		1,6	2,1
Coolant inlet temperature [5]	T_{ein}	°C	+10...+40				
Coolant temperature rise at P_V [5]	ΔT_{diff}	K	10				
Required coolant flow for ΔT_{diff} [5]	Q_{min_H2O}	l/min	3	3		4	4
Pressure drop at Q_{min}	Δp_{diff}	bar	1,6				
Permissible inlet pressure	p_{max}	bar	5				
Volume liquid cooling duct	V_{kuehl}	l	0,051	0,063		0,076	0,101

i.p. = in preparation
1) The determined values are root-mean-squares according to IEC 60034-1, if no others are given. Reference value 540 V_{DC}
2) The achievable maximum torque depends on the drive controller used.
3) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross sections may be necessary.
For notes regarding connection cables on the motor see chapter 8.2
EMV = electromagnetic force Root-mean-square applying to 1000 min^{-1}.
The data refer to operation with liquid cooling, cooling medium water.
For additional notes for coolant inlet temperature see chapter 9.5
6) Values for rotor design "1N" with bigger available rotor internal diameter
7) Values for rotor design "2N" with bigger available rotor internal diameter

Fig. 4-11: Technical Data Size 202

4.7 Data Sheet Size 242

Description		Symbol	Unit	Size 242		
Motor data [1]						
Frame length				B	D	F
Winding code				0100	0070	0060
Rated torque		M_{nenn}	Nm	250	375	425
Rated speed		n_{nenn}	rpm	1000	700	600
Rated power		P_{nenn}	KW	26,2	27,5	26,7
Rated current		I_{nenn}	A	68	49,5	68
Maximum torque [2]		M_{max}	Nm	575	860	970
Maximum current		I_{max}	A	180	180	180
Maximum speed		n_{max}	rpm	4000	2800	2400
Minimum cross-section power cable [3]		A	mm²	16	10	16
Moment of inertia for rotor type 1N [6]		J_{rot}	kgm²	0,119	0,167	0,193
Moment of inertia for rotor type 2N [7]				0,128	0,18	0,207
Torque constant at 20°C		K_{M_nenn}	Nm/A	3,68	6,6	6,25
Constant voltage at 20°C [4]		K_{EMK_1000}	V/ rpm	310	454	570
Winding resistance at 20°C		R12	Ohm	0,65	0,48	0,41
Winding inductivity	longitudinal	L_d	mH	3	8,2	3
	across	L_q	mH	8,8	14,3	13,3
Thermal time constant		T_{th}	min	7,3	7,3	7,3
Mass	Rotor [6]	m_{rot}	kg	22,5	31,7	36,5
	Stator	m_{stat}	kg	66,7	92,3	105,1
Permissible ambient temperature		T_{um}	°C	0...+40		
Permissible storage and transport temperature		T_{lager}	°C	-20...+80		
Insulation class				F		
International protection class acc. to IEC60050-411				IP00		
Number of pole pairs		p		5		
Liquid Cooling						
Rated power loss		P_{V_H2O}	kW	2,3	3,3	3,8
Coolant inlet temperature [5]		T_{ein}	°C	+10...+40		
Coolant temperature rise at P_V [5]		ΔT_{diff}	K	10		
Necessary coolant flow for ΔT_{diff} [5]		Q_{min_H2O}	l/min	4	5	6
Pressure drop at Q_{min}		Δp_{diff}	bar	1,2		
Permissible inlet pressure		p_{max}	bar	5		
Volume liquid cooling duct		V_{kuehl}	l	0,076	0,107	0,122

1) The determined values are root-mean-squares according to IEC 60034-1, if no others are given. Reference value 540 V_{DC}
2) The achievable maximum torque depends on the drive controller used.
3) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross sections may be necessary.
For notes regarding connection cables on the motor see chapter 8.2
EMV = electromagnetic force Root-mean-square applying to 1000 min^{-1}.
The data refer to operation with liquid cooling, cooling medium water.
For additional notes for coolant inlet temperature see chapter 9.5
6) Values for rotor design "1N" with bigger available rotor internal diameter
7) Values for rotor design "2N" with bigger available rotor internal diameter

Fig. 4-12: Technical Data Size 242

Rexroth Bosch Group

4.8 Data Sheet Size 272

Description		Symbol	Unit	Size 272		
Motor data [1]						
Frame length				B	D	F
Winding code				0065	0050	0040
Rated torque		M_{nenn}	Nm	400	525	650
Rated speed		n_{nenn}	rpm	650	500	400
Rated power		P_{nenn}	KW	27,2	27,5	27,2
Rated current		I_{nenn}	A	71	71	71
Maximum torque [2]		M_{max}	Nm	900	1200	1500
Maximum current		I_{max}	A	200	200	200
Maximum speed		n_{max}	rpm	2600	2000	1600
Minimum cross-section power cable [3]		A	mm²	16	16	16
Moment of inertia for rotor type 1N [6]		J_{rot}	kgm²	0,268	0,335	0,403
Moment of inertia for rotor type 2N [7]				0,287	0,36	0,433
Torque constant at 20°C		K_{M_nenn}	Nm/A	5,63	7,39	9,15
Constant voltage at 20°C [4]		K_{EMK_1000}	V/ rpm	520	620	775
Winding resistance at 20°C		R12	Ohm	0,298	0,37	0,5
Winding inductivity	longitudinal	L_d	mH	2	4	4,4
	across	L_q	mH	10,2	13,5	16,9
Thermal time constant		T_{th}	min	i.p.	i.p.	i.p.
Mass	Rotor [6]	m_{rot}	kg	35,5	44,5	53,5
	Stator	m_{stat}	kg	90,4	112,3	134,2
Permissible ambient temperature		T_{um}	°C	0...+40		
Permissible storage and transport temperature		T_{lager}	°C	-20...+80		
Insulation class				F		
International protection class acc. to IEC60050-411				IP00		
Number of pole pairs		p		6		
Liquid Cooling						
Rated power loss		P_{V_H2O}	kW	3,8	4,5	4,9
Coolant inlet temperature [5]		T_{ein}	°C	+10...+40		
Coolant temperature rise at P_V [5]		ΔT_{diff}	K	10		
Necessary coolant flow for ΔT_{diff} [5]		Q_{min_H2O}	l/min	6	7	7
Pressure drop at Q_{min}		Δp_{diff}	bar	1,2		
Permissible inlet pressure		p_{max}	bar	5		
Volume liquid cooling duct		V_{kuehl}	l	0,075	0,091	0,108

i.p. = in preparation
1) The determined values are root-mean-squares according to IEC 60034-1, if no others are given. Reference value 540 V_{DC}
2) The achievable maximum torque depends on the drive controller used.
3) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross sections may be necessary.
For notes regarding connection cables on the motor see chapter 8.2
EMV = electromagnetic force Root-mean-square applying to 1000 min^{-1}.
The data refer to operation with liquid cooling, cooling medium water.
For additional notes for coolant inlet temperature see chapter 9.5
6) Values for rotor design "1N" with bigger available rotor internal diameter
7) Values for rotor design "2N" with bigger available rotor internal diameter

Fig. 4-13: Technical Data Size 272

4.9 Data Sheet Size 312

Description		Symbol	Unit	Size 312				
Motor data [1]								
Frame length				B	D	F	H	
Winding code				0035	0028	0028	0025	0085
Rated torque		M_{nenn}	Nm	650	820	975	1125	1100
Rated speed		n_{nenn}	rpm	350	280	280	250	850
Rated power		P_{nenn}	KW	23,8	24	28,6	29,5	97,9
Rated current		I_{nenn}	A	62	59,5	62	62	197
Maximum torque [2]		M_{max}	Nm	1550	1950	2275	2750	2750
Maximum current		I_{max}	A	180	160	180	180	570
Maximum speed		n_{max}	rpm	1400	1120	1120	1000	3400
Minimum cross-section power cable [3]		A	mm²	16	16	16	16	2x25
Moment of inertia for rotor type 1N [6]		J_{rot}	kgm²	0,617	0,751	0,885	1,064	
Moment of inertia for rotor type 2N [7]				0,664	0,809	0,953	1,146	
Torque constant at 20°C		K_{M_nenn}	Nm/A	10,48	13,78	15,72	20,5	5,6
Constant voltage at 20°C [4]		K_{EMK_1000}	V/ rpm	850	926	930	1250	375
Winding resistance at 20°C		R12	Ohm	0,464	0,77	0,59	0,95	0,07
Winding inductivity	longitudinal	L_d	mH	2,01	8,25	15	20,8	1,8
	across	L_q	mH	5,67	10,4	18,8	26	2,25
Thermal time constant		T_{th}	min	7,5	7,8	7,8	8	
Mass	Rotor [6]	m_{rot}	kg	55	67,4	79,5	95,6	
	Stator	m_{stat}	kg	128,7	154,1	179,5	215	
Permissible ambient temperature		T_{um}	°C	0...+40				
Permissible storage and transport temperature		T_{lager}	°C	-20...+80				
Insulation class				F				
International protection class acc. to IEC60050-411				IP00				
Number of pole pairs		p		7				
Liquid Cooling								
Rated power loss		P_V	kW	4,8	5,0	5,3	5,6	6
Coolant inlet temperature [5]		T_{ein}	°C	+10...+40				
Coolant temperature rise at P_V [5]		ΔT_{diff}	K	10				
Necessary coolant flow for ΔT_{diff} [5]		Q_{min}	l/min	7	7,3	7,7	8,3	8,7
Pressure drop at Q_{min}		Δp_{diff}	bar	0,5				
Permissible inlet pressure		p_{max}	bar	5				
Volume liquid cooling duct		V_{kuehl}	l	0,126	0,152	0,179	0,207	

1) The determined values are root-mean-squares according to IEC 60034-1, if no others are given. Reference value 540 V_{DC}
2) The achievable maximum torque depends on the drive controller used.
3) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross sections may be necessary.
For notes regarding connection cables on the motor see chapter 8.2
EMV = electromagnetic force Root-mean-square applying to 1000 min^{-1}.
The data refer to operation with liquid cooling, cooling medium water.
For additional notes for coolant inlet temperature see chapter 9.5
6) Values for rotor design “1N” with bigger available rotor internal diameter
7) Values for rotor design “2N” with bigger available rotor internal diameter

Fig. 4-14: Technical Data Size 312

4.10 Preliminary Data Sheet Size 382

Description		Symbol	Unit	Size 382		
Motor data [1]						
Frame length				B	D	F
Winding code				0025	0020	0018
Rated torque		M_{nenn}	Nm	1375	1775	2170
Rated speed		n_{nenn}	rpm	250	200	180
Rated power		P_{nenn}	KW	36	37,2	40,9
Rated current		I_{nenn}	A	85	85	83,6
Maximum torque [2]		M_{max}	Nm	2875	3700	4500
Maximum current		I_{max}	A	250	250	250
Maximum speed		n_{max}	rpm	1000	800	720
Minimum cross-section power cable [3]		A	mm²	16	16	16
Moment of inertia for rotor type 1N [6]		J_{rot}	kgm²	1,525	1,911	2,296
Moment of inertia for rotor type 2N [7]				1,682	2,108	2,533
Torque constant at 20°C		K_{M_nenn}	Nm/A	16,18	20,88	28
Constant voltage at 20°C [4]		K_{EMK_1000}	V/ rpm	1250	1550	1842
Winding resistance at 20°C		R12	Ohm	0,48	0,61	0,9
Winding inductivity	longitudinal	L_d	mH	6,1	16	13
	across	L_q	mH	19,8	21,2	17,3
Thermal time constant		T_{th}	min	9,8	9,8	9,8
Mass	Rotor [6]	m_{rot}	kg	77,6	97,2	120
	Stator	m_{stat}	kg	178,5	220,1	262
Permissible ambient temperature		T_{um}	°C	0...+40		
Permissible storage and transport temperature		T_{lager}	°C	-20...+80		
Insulation class				F		
International protection class acc. to IEC60050-411				IP00		
Number of pole pairs		p		9		
Liquid Cooling						
Rated power loss		P_{V_H2O}	kW	6,4	8,2	10
Coolant inlet temperature [5]		T_{ein}	°C	+10...+40		
Coolant temperature rise at P_V [5]		ΔT_{diff}	K	10		
Necessary coolant flow for ΔT_{diff} [5]		Q_{min_H2O}	l/min	9,2	11,8	14,4
Pressure drop at Q_{min}		Δp_{diff}	bar	1		
Permissible inlet pressure		p_{max}	bar	5		
Volume liquid cooling duct		V_{kuehl}	l	0,73	0,91	1,09

i.p. = in preparation
[1]) The determined values are root-mean-squares according to IEC 60034-1, if no others are given. Reference value 540 V_{DC}
[2]) The achievable maximum torque depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross sections may be necessary.
For notes regarding connection cables on the motor see chapter 8.2
EMV = electromagnetic force Root-mean-square applying to 1000 min^{-1}.
The data refer to operation with liquid cooling, cooling medium water.
For additional notes for coolant inlet temperature see chapter 9.5
[6]) Values for rotor design “1N” with bigger available rotor internal diameter
[7]) Values for rotor design “2N” with bigger available rotor internal diameter

Fig. 4-15: Technical Data Size 382

5 Dimensional Sheet IndraDyn H

For your orientation:

The dimensioned drawings in this chapter are combined according to the sizes. The drawings for each size always follow in this order:

- Dimension sheet of the complete motor with axial cooling connection and rotor design “1N”.
- Dimension sheet of the complete motor with axial cooling connection and rotor design “2N”.
- Dimension sheet of the complete motor with radial cooling connection and rotor design “1N” (only for sizes 182 and 312).
- Dimension sheet of the complete motor with radial cooling connection and rotor design “2N” (only for sizes 182 and 312).

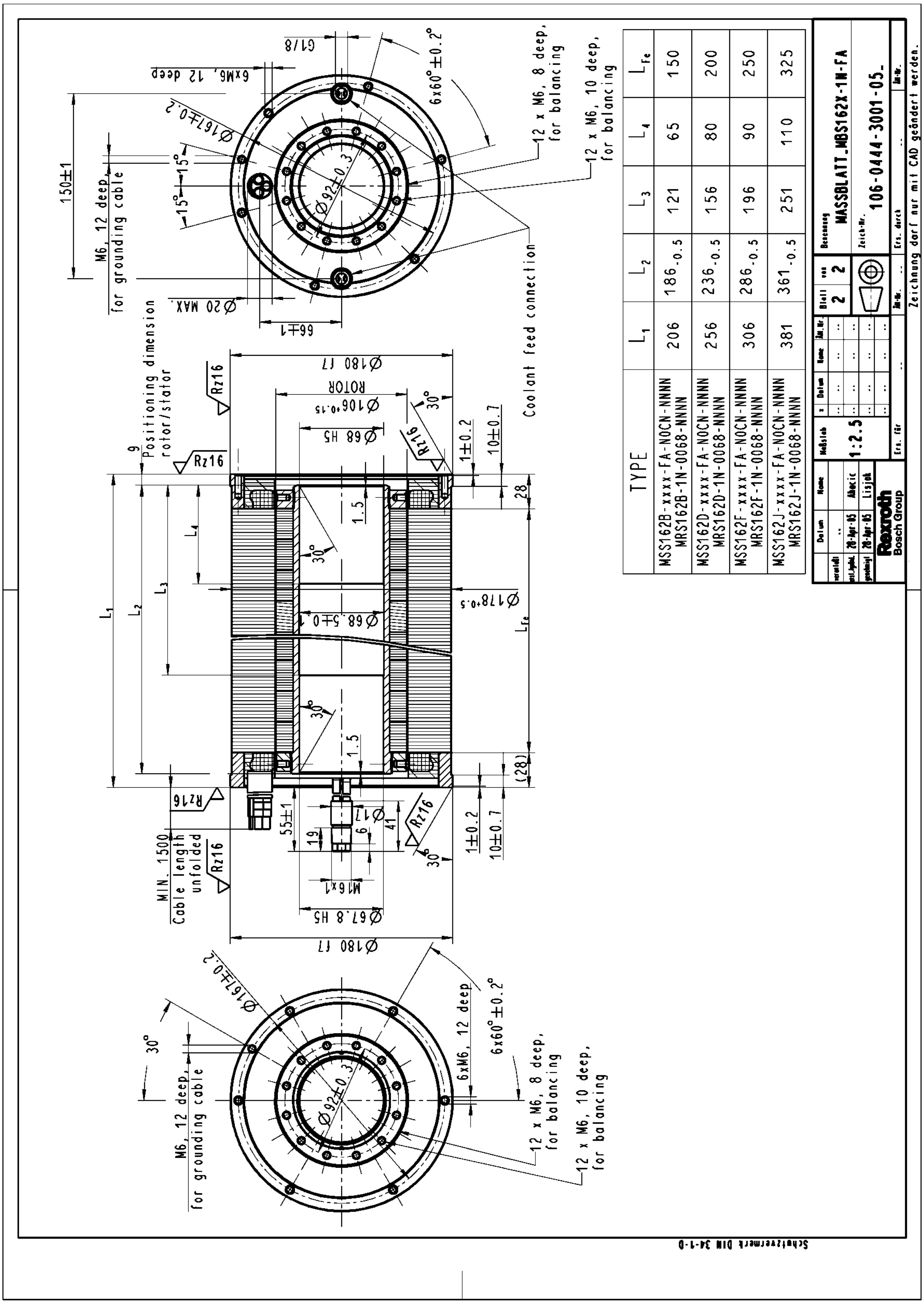
- Single part drawing of the stator with axial cooling connection
- Single part drawing of the stator with radial cooling connection (only for size 182)
- Single part drawing of the rotor in design “1N”
- Single part drawing of the rotor in design “2N”

The dimensions and tolerances shown in the drawings underlie the following standards:

Longitudinal dimensions:	DIN ISO 2768, part 1
Angular dimension:	DIN 7168 middle
Form and position tolerance:	DIN ISO 1101

5.1 Size 162

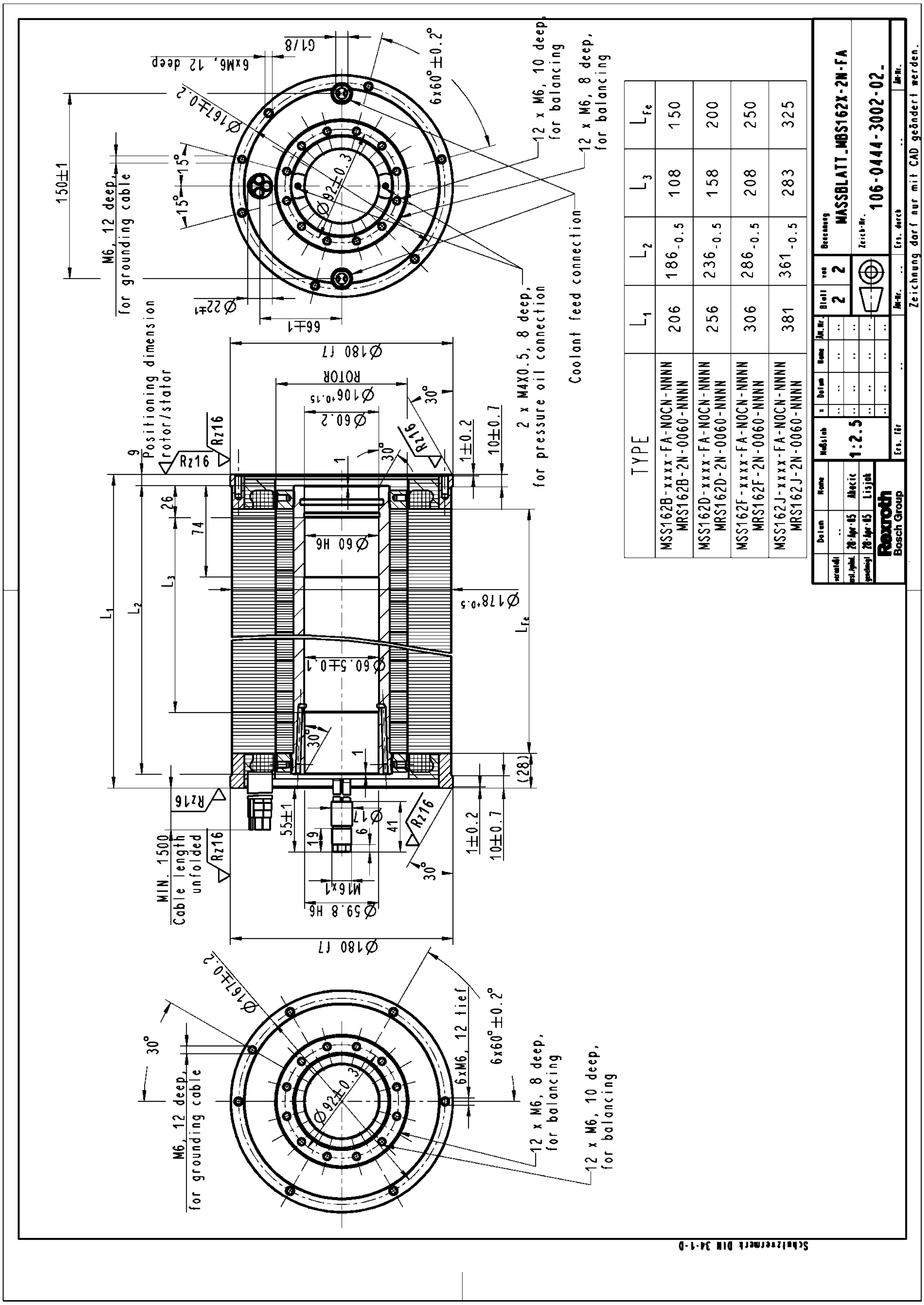
MBS162 with Axial Cooling Connection and Rotor Design “1N”



106-0444-3001-05.tif

Fig. 5-1: MBS162 with Axial Cooling Connection and Rotor Design “1N”

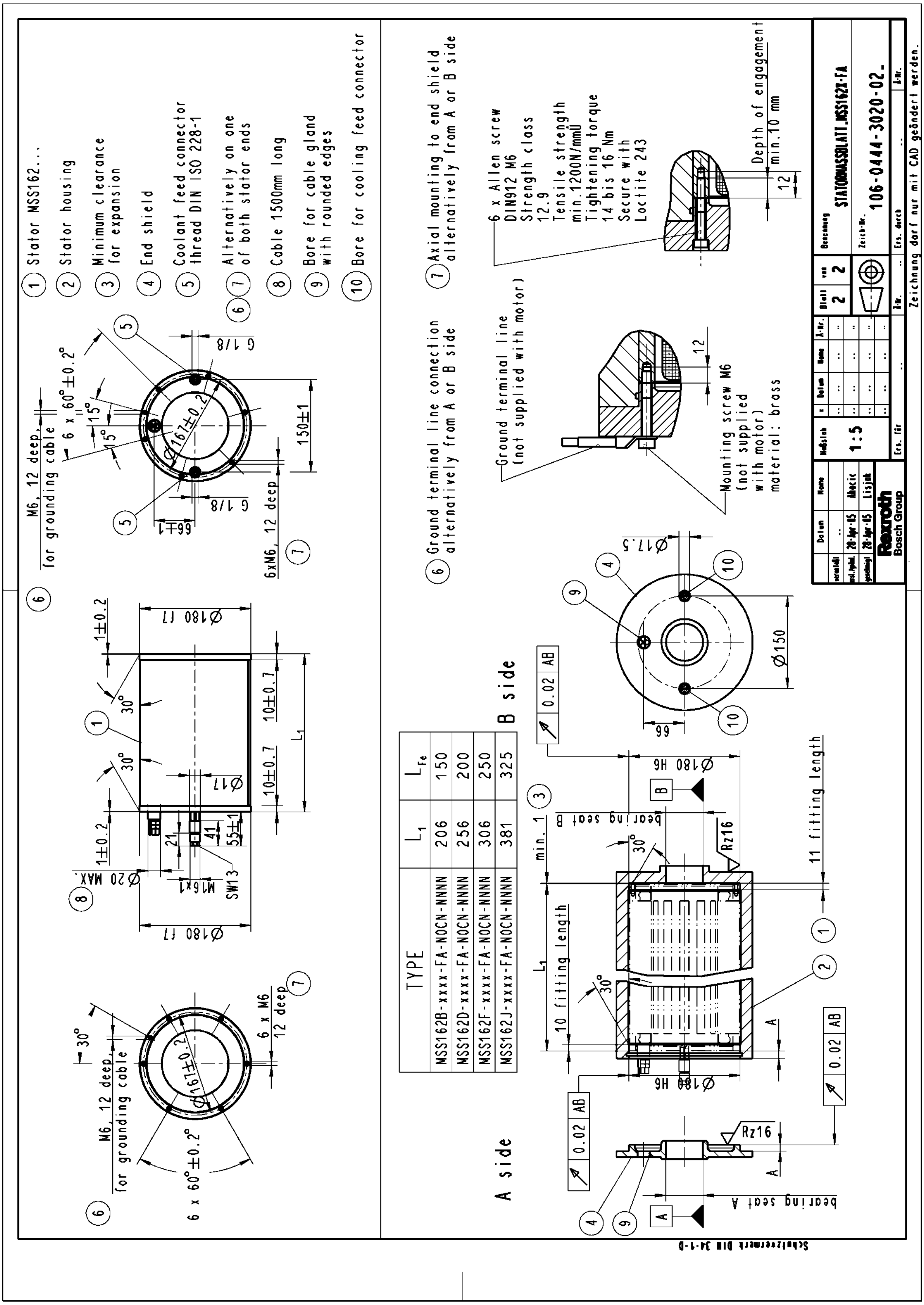
MBS162 with Axial Cooling Connection and Rotor Design “2N”



106-0444-3002-02.tif

Fig. 5-2: MBS162 with Axial Cooling Connection and Rotor Design “2N”

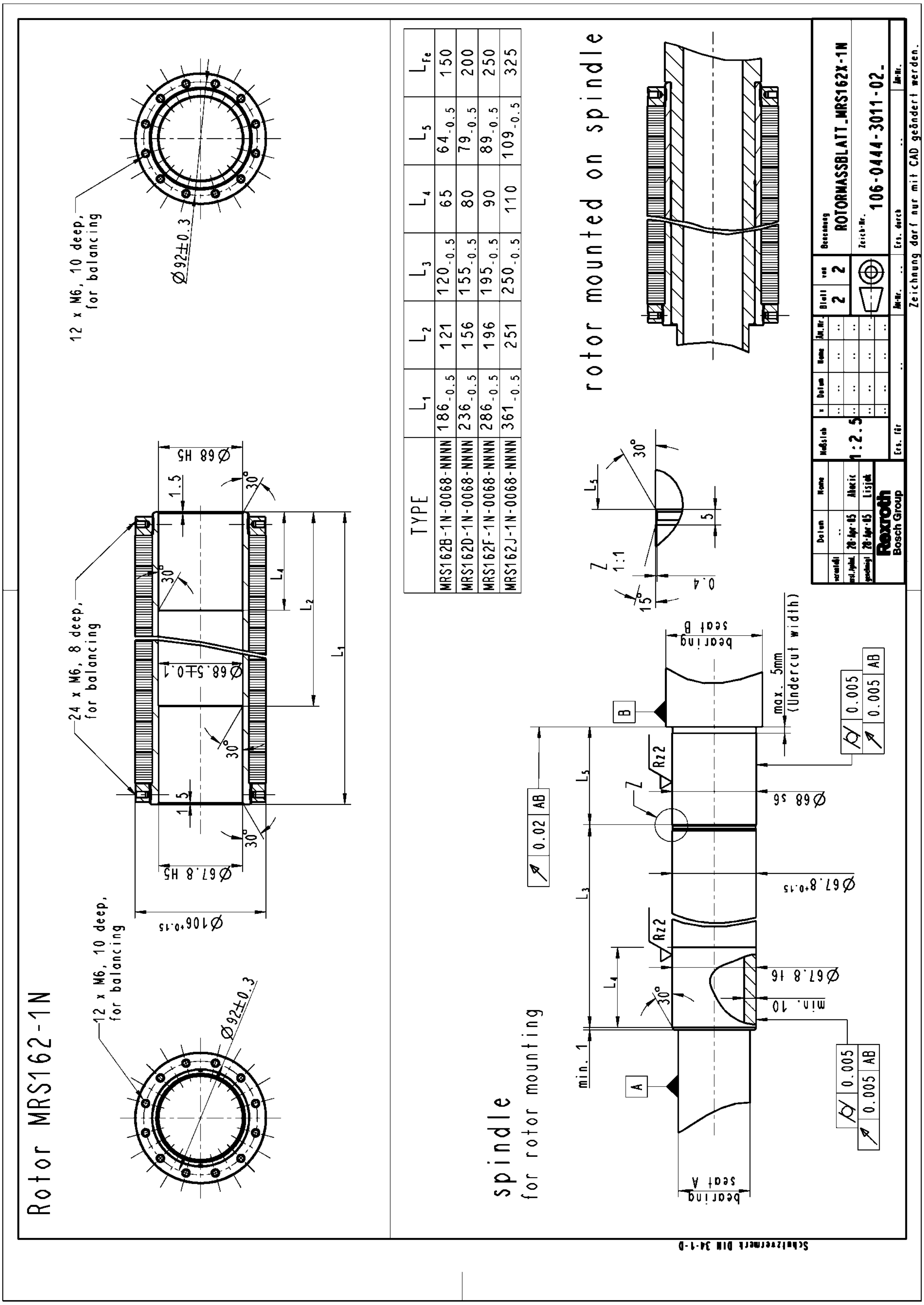
MSS162, axial cooling connection



106-0444-3020-02.tif

Fig. 5-3: MSS162, axial cooling connection

MRS162 with 1N Design (Smooth Hole)

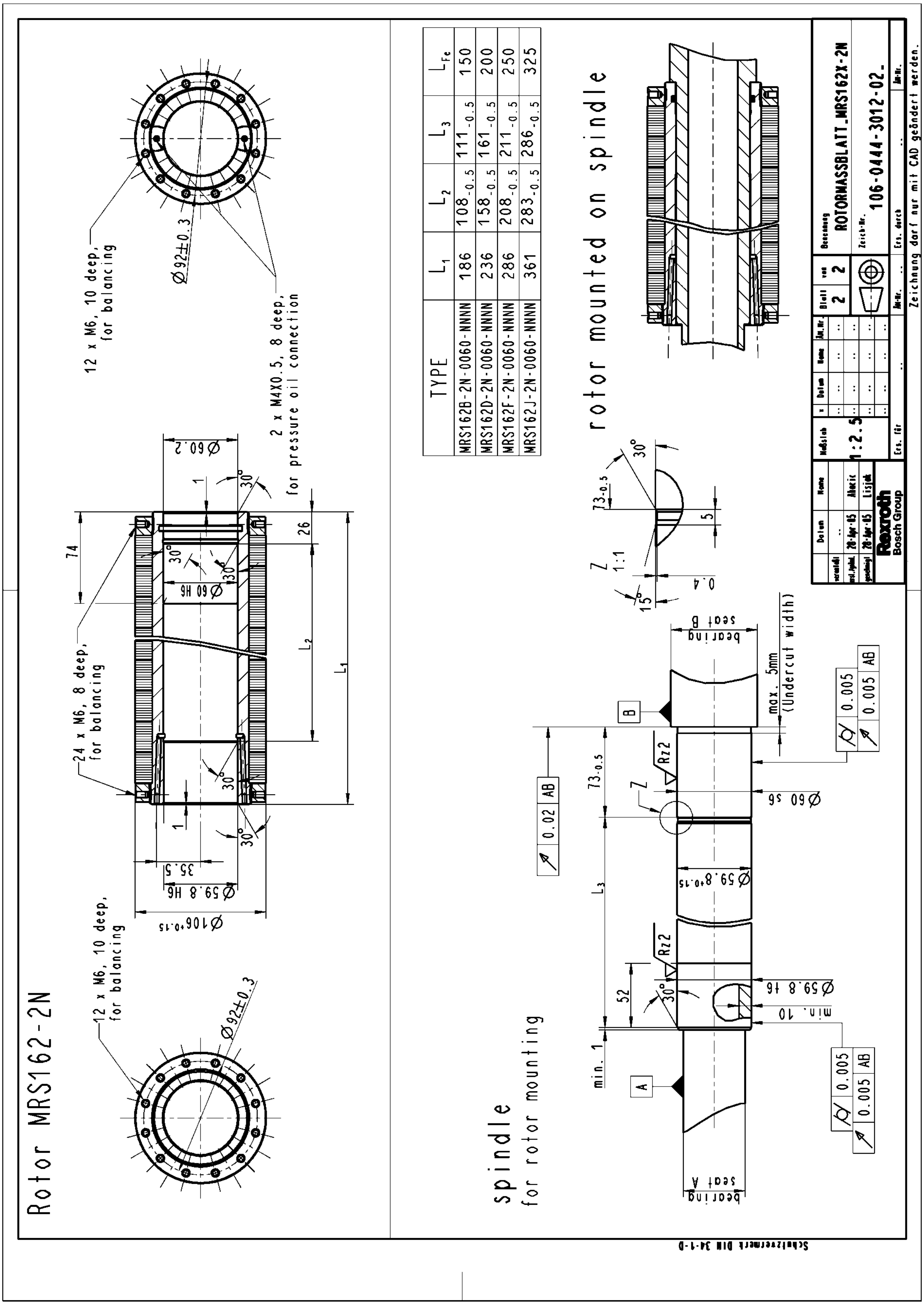


TYPE	L_1	L_2	L_3	L_4	L_5	L_{Fe}
MRS162B-1N-0068-NNNN	$186_{-0.5}$	121	$120_{-0.5}$	65	$64_{-0.5}$	150
MRS162D-1N-0068-NNNN	$236_{-0.5}$	156	$155_{-0.5}$	80	$79_{-0.5}$	200
MRS162F-1N-0068-NNNN	$286_{-0.5}$	196	$195_{-0.5}$	90	$89_{-0.5}$	250
MRS162J-1N-0068-NNNN	$361_{-0.5}$	251	$250_{-0.5}$	110	$109_{-0.5}$	325

106-0444-3011-02.TIF

Fig. 5-4: MRS162 in design 1N

MRS162 with 2N Design (Step Interference Fit)



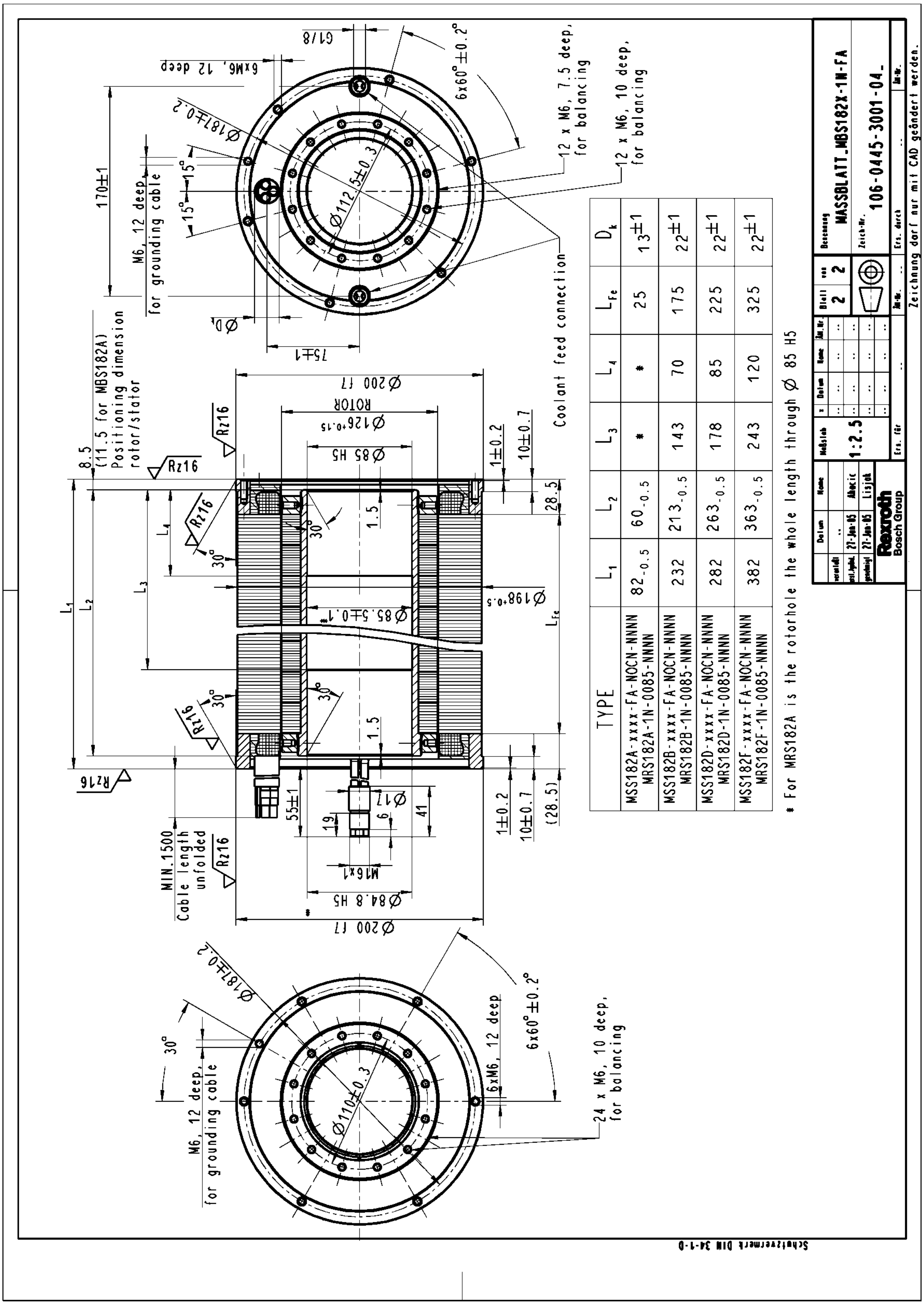
TYPE	L_1	L_2	L_3	L_{Fe}
MRS162B-2N-0060-NNNN	186	$108_{-0.5}$	$111_{-0.5}$	150
MRS162D-2N-0060-NNNN	236	$158_{-0.5}$	$161_{-0.5}$	200
MRS162F-2N-0060-NNNN	286	$208_{-0.5}$	$211_{-0.5}$	250
MRS162J-2N-0060-NNNN	361	$283_{-0.5}$	$286_{-0.5}$	325

106-0444-3012-02.tif

Fig. 5-5: MRS162 in design 2N

5.2 Size 182

MBS182 with Axial Cooling Connection and Rotor Design “1N”



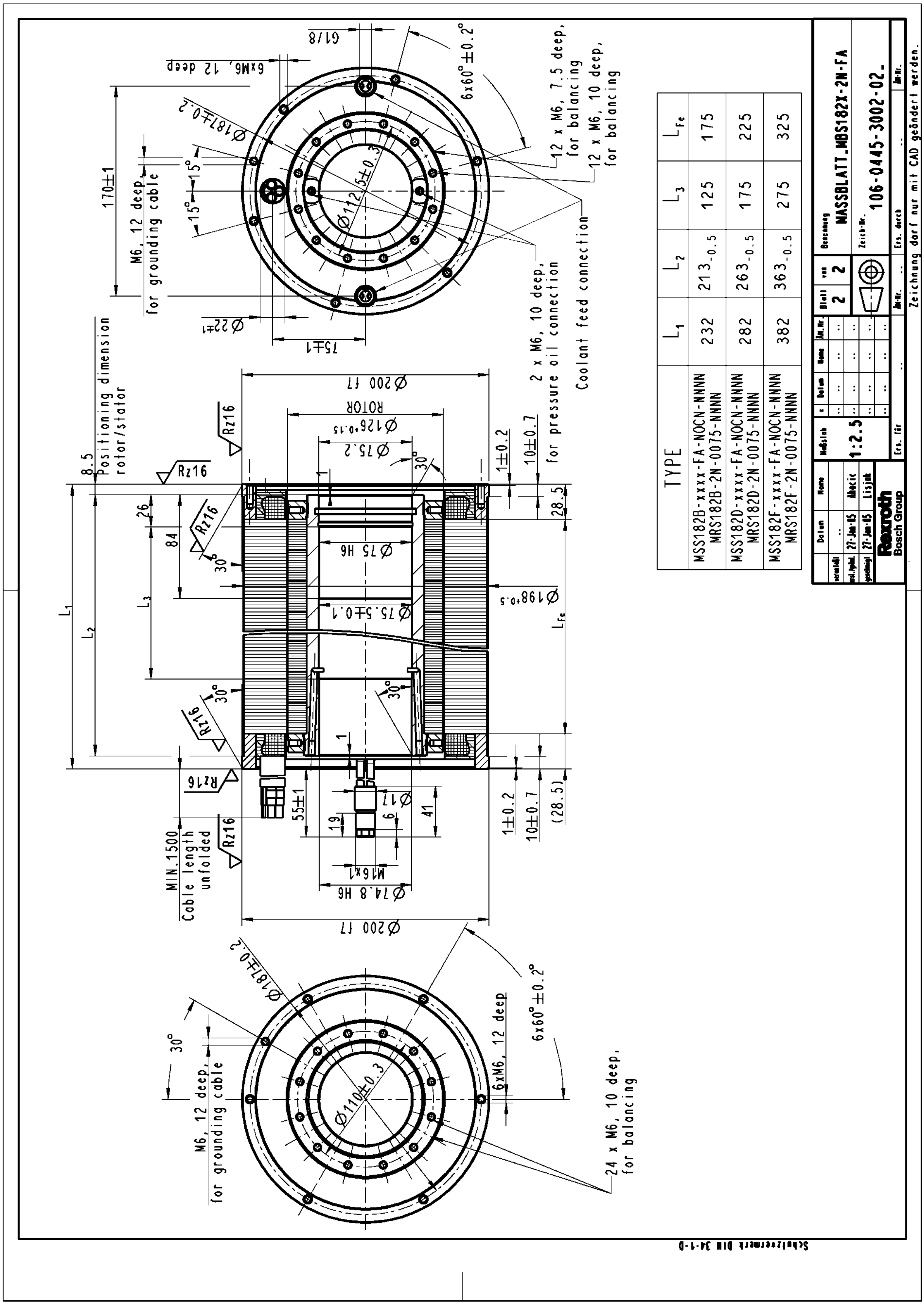
TYPE	L_1	L_2	L_3	L_4	L_{Fe}	D_k
MSS182A-xxxx-FA-NOCN-NNNN MRS182A-1N-0085-NNNN	$82_{-0.5}$	$60_{-0.5}$	*	*	25	$13^{\pm1}$
MSS182B-xxxx-FA-NOCN-NNNN MRS182B-1N-0085-NNNN	232	$213_{-0.5}$	143	70	175	$22^{\pm1}$
MSS182D-xxxx-FA-NOCN-NNNN MRS182D-1N-0085-NNNN	282	$263_{-0.5}$	178	85	225	$22^{\pm1}$
MSS182F-xxxx-FA-NOCN-NNNN MRS182F-1N-0085-NNNN	382	$363_{-0.5}$	243	120	325	$22^{\pm1}$

* For MRS182A is the rotorhole the whole length through Ø 85 H5

106-0445-3001-04.tif

Fig. 5-6: MBS182 with Axial Cooling Connection and Rotor Design “1N”

MBS182 with Axial Cooling Connection and Rotor Design “2N”

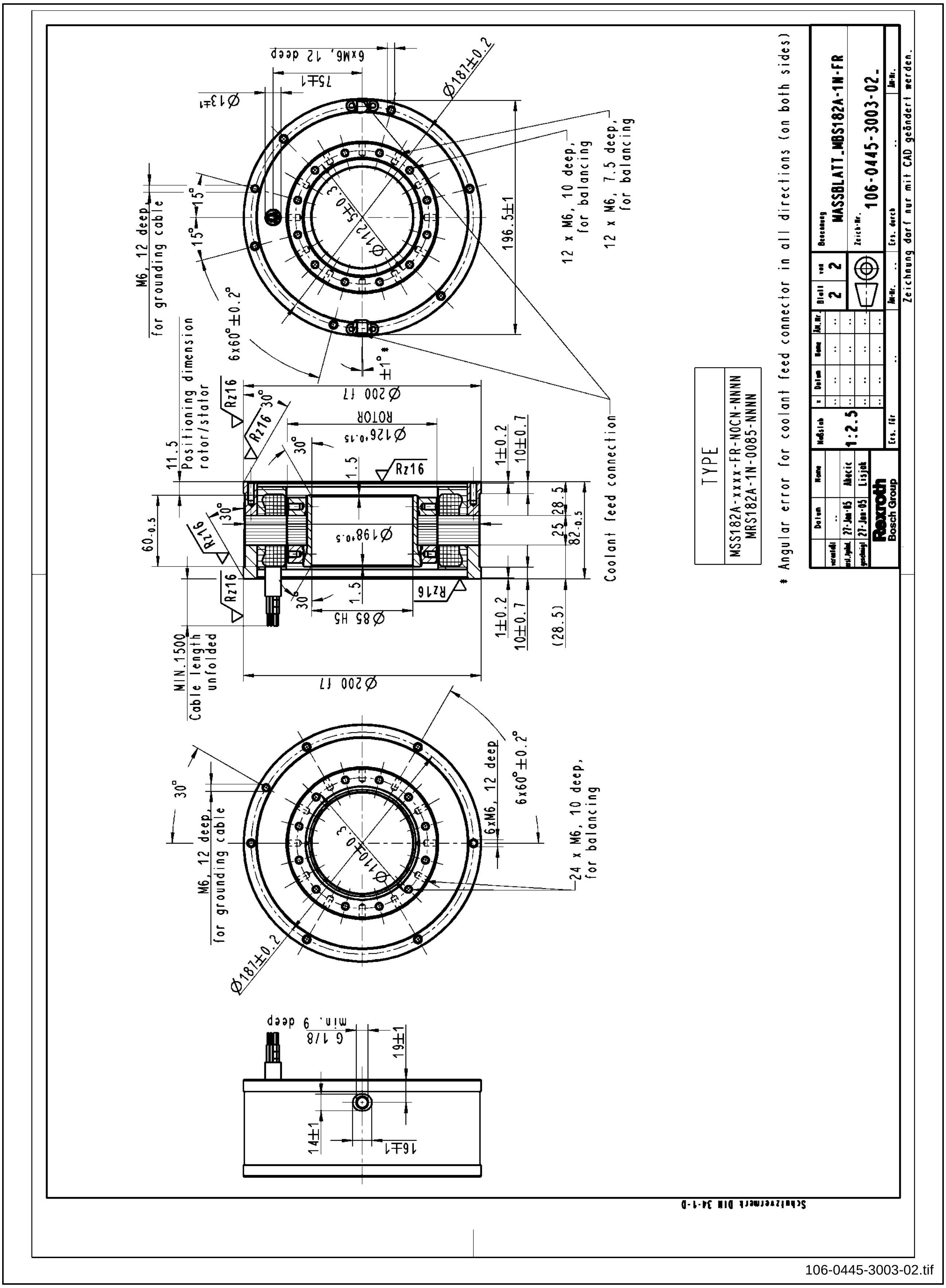


TYPE	L_1	L_2	L_3	L_{Fe}
MSS182B-xxxx-FA-NOCN-NNNN MRS182B-2N-0075-NNNN	232	$213_{-0.5}$	125	175
MSS182D-xxxx-FA-NOCN-NNNN MRS182D-2N-0075-NNNN	282	$263_{-0.5}$	175	225
MSS182F-xxxx-FA-NOCN-NNNN MRS182F-2N-0075-NNNN	382	$363_{-0.5}$	275	325

106-0445-3002-02.tif

Fig. 5-7: MBS182 with Axial Cooling Connection and Rotor Design “2N”

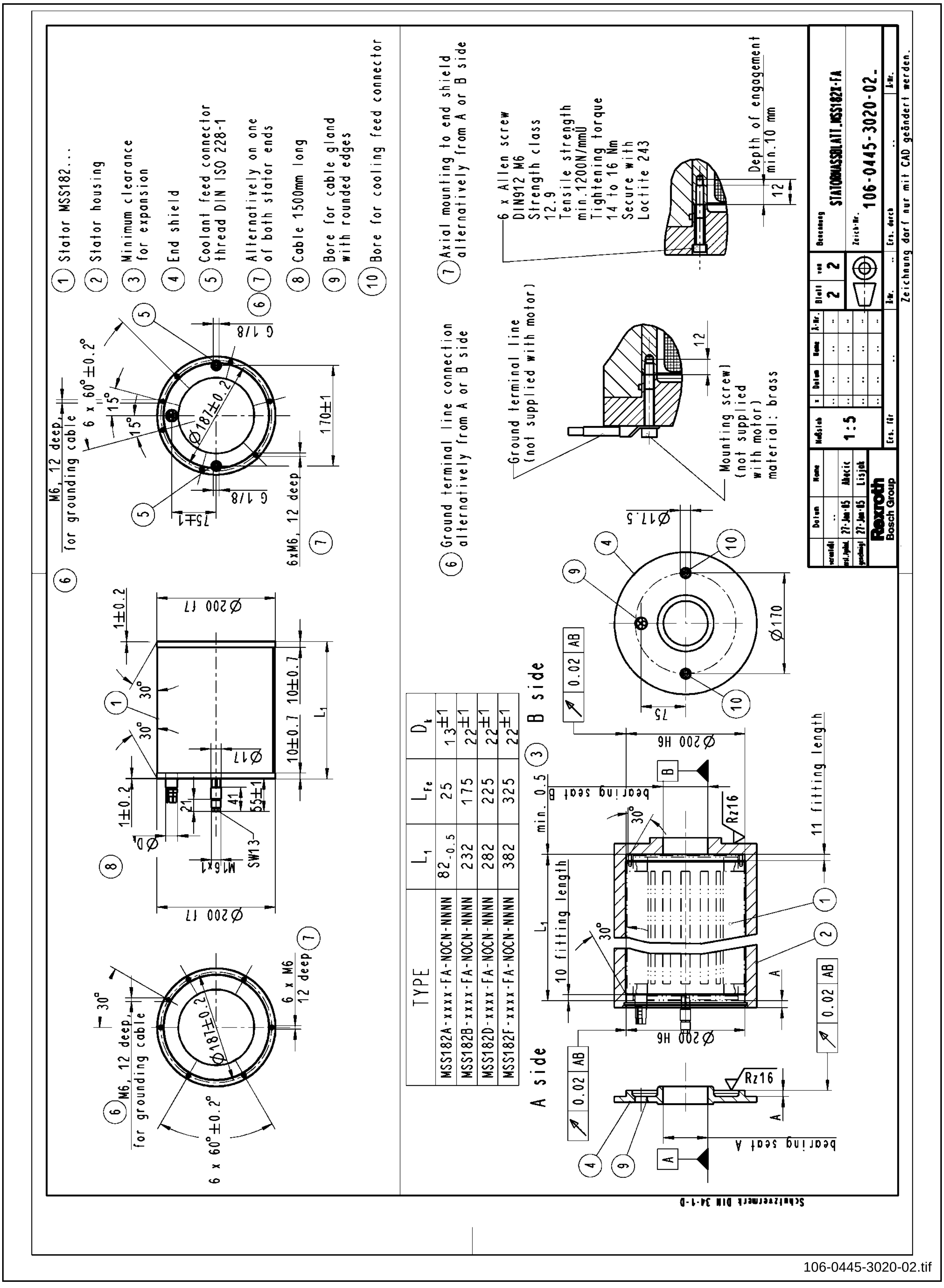
MBS182A with Radial Cooling Connection and Rotor Design “1N”



106-0445-3003-02.tif

Fig. 5-8: MBS182A with Radial Cooling Connection and Rotor Design “1N”

MSS182, axial cooling connection

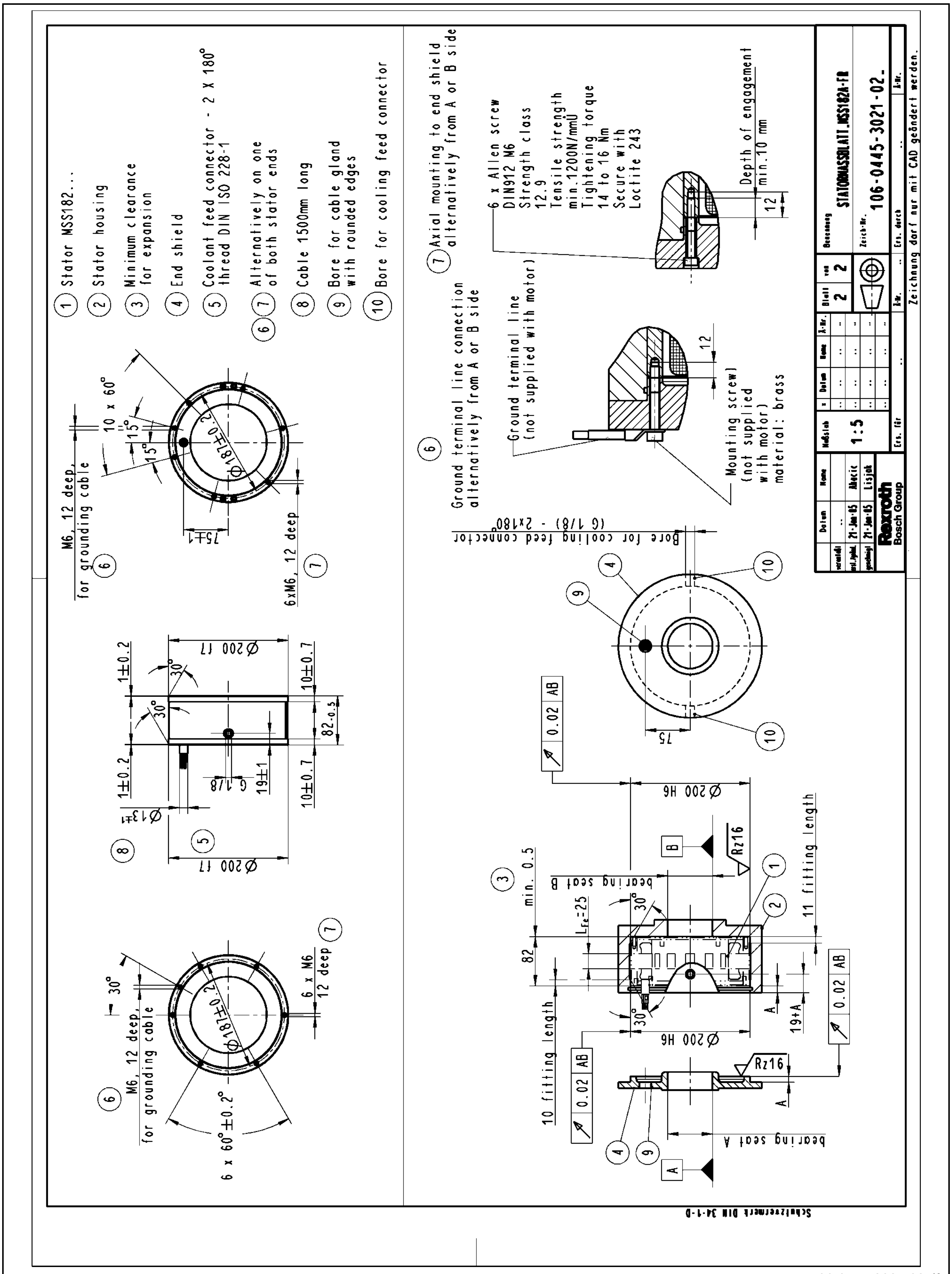


TYPE	L_1	L_{Fe}	D_k
MSS182A-xxxx-FA-NOCN-NNNN	$82_{-0.5}$	25	13±1
MSS182B-xxxx-FA-NOCN-NNNN	232	175	22±1
MSS182D-xxxx-FA-NOCN-NNNN	282	225	22±1
MSS182F-xxxx-FA-NOCN-NNNN	382	325	22±1

106-0445-3020-02.tif

Fig. 5-9: MSS182, axial cooling connection

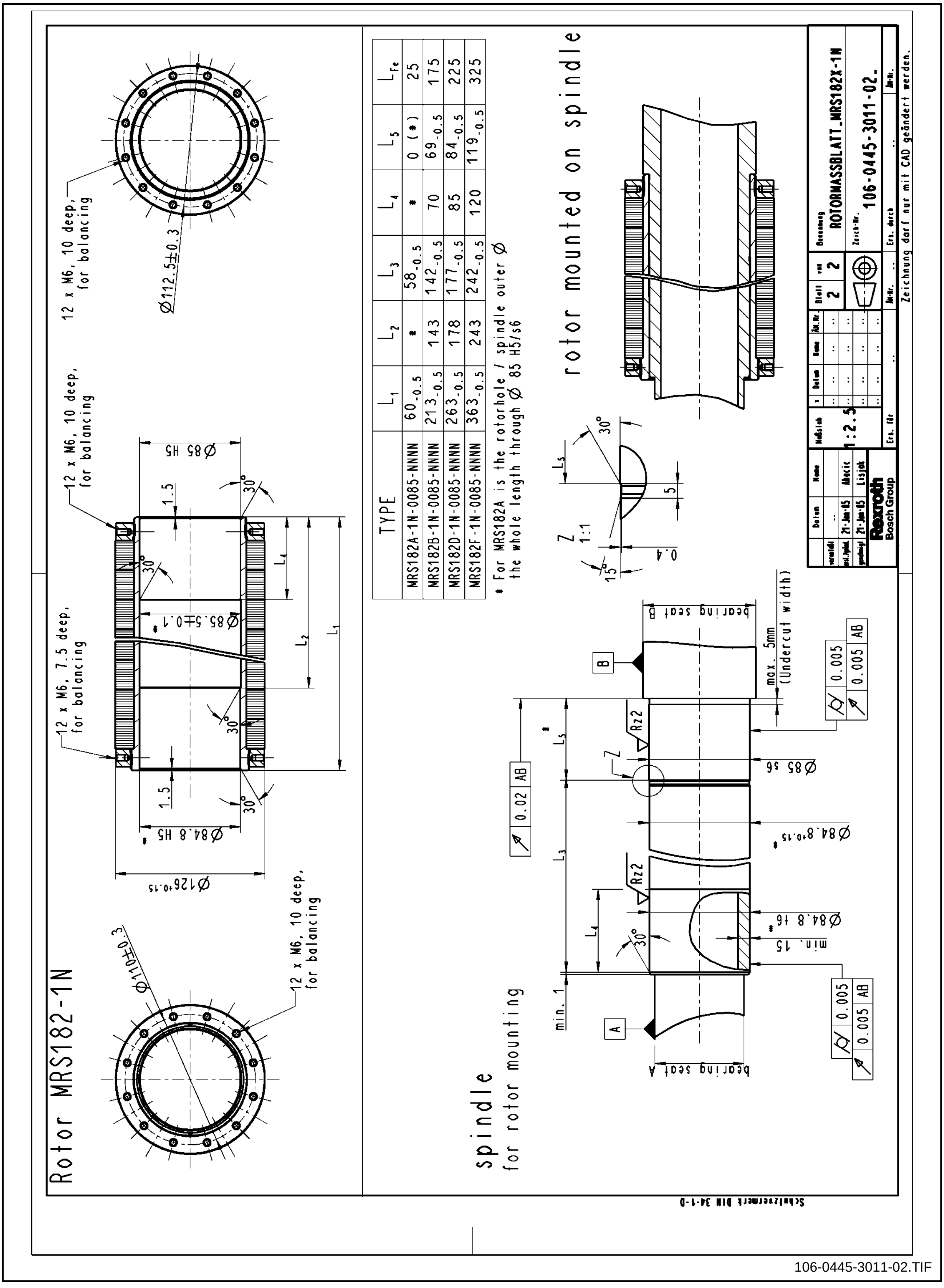
MSS182, radial cooling connection



106-0445-3021-02.tif

Fig. 5-10: MSS182, radial cooling connection

MRS182 with 1N Design (Smooth Hole)



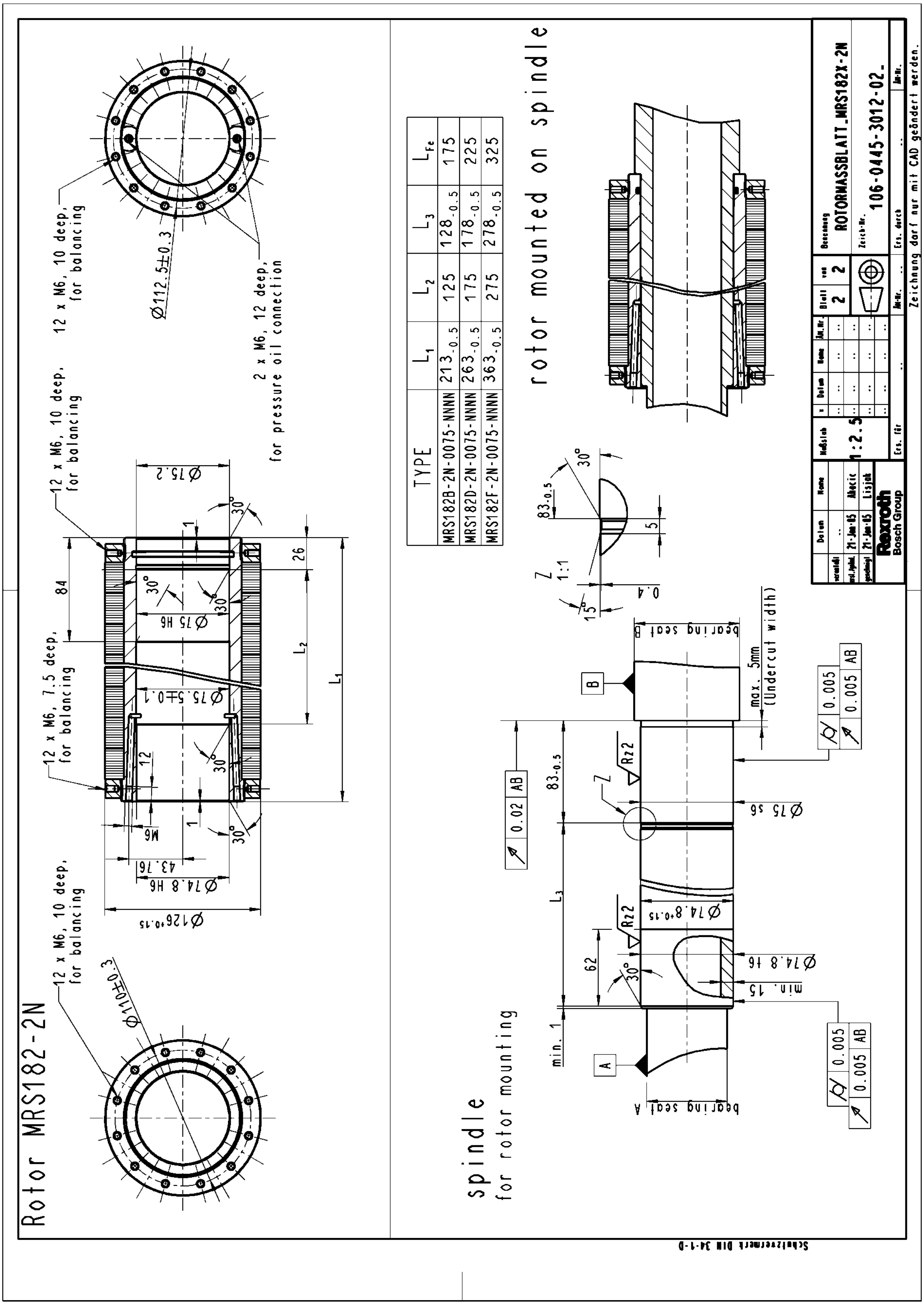
TYPE	L_1	L_2	L_3	L_4	L_5	L_{Fe}
MRS182A-1N-0085-NNNN	$60_{-0.5}$	*	$58_{-0.5}$	*	0 (*)	25
MRS182B-1N-0085-NNNN	$213_{-0.5}$	143	$142_{-0.5}$	70	$69_{-0.5}$	175
MRS182D-1N-0085-NNNN	$263_{-0.5}$	178	$177_{-0.5}$	85	$84_{-0.5}$	225
MRS182F-1N-0085-NNNN	$363_{-0.5}$	243	$242_{-0.5}$	120	$119_{-0.5}$	325

* For MRS182A is the rotorhole / spindle outer Ø the whole length through Ø 85 H5/s6

106-0445-3011-02.TIF

Fig. 5-11: MRS182 in design 1N

MRS182 with 2N Design (Step Interference Fit)



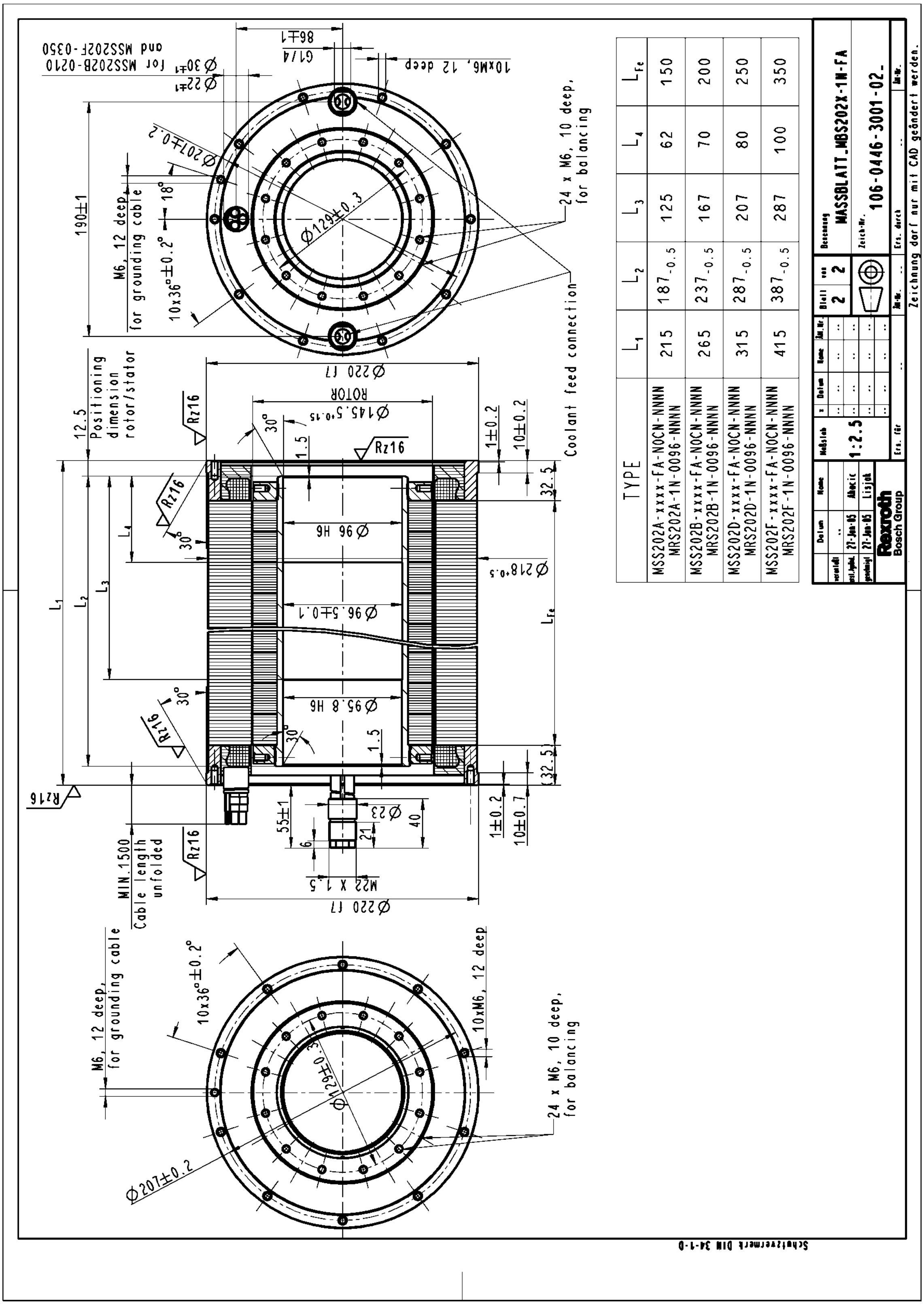
TYPE	L_1	L_2	L_3	L_{Fe}
MRS182B-2N-0075-NNNN	$213_{-0.5}$	125	$128_{-0.5}$	175
MRS182D-2N-0075-NNNN	$263_{-0.5}$	175	$178_{-0.5}$	225
MRS182F-2N-0075-NNNN	$363_{-0.5}$	275	$278_{-0.5}$	325

106-0445-3012-02.tif

Fig. 5-12: MRS182 in design 2N

5.3 Size 202

MBS202 with Axial Cooling Connection and Rotor Design “1N”

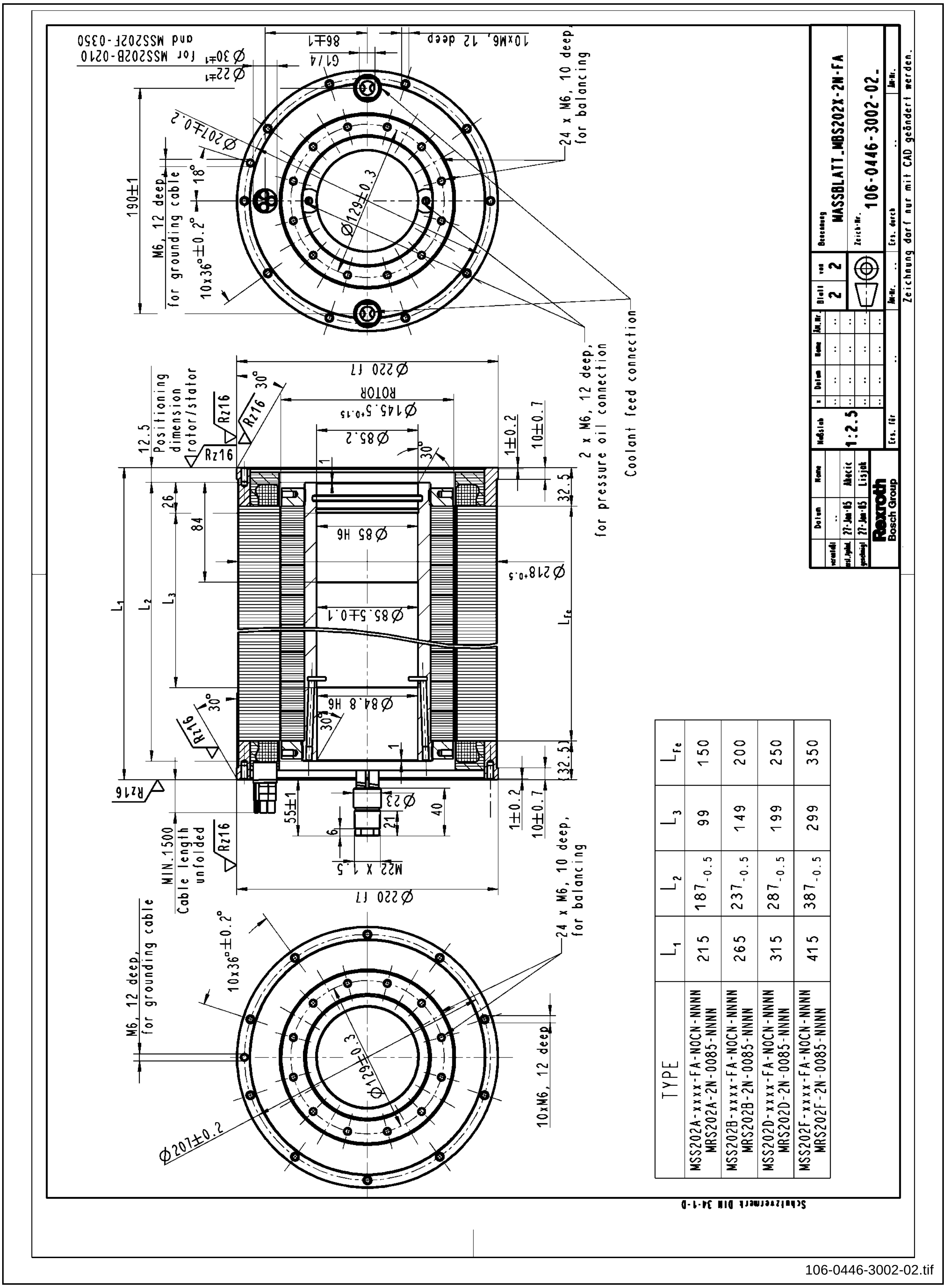


TYPE	L_1	L_2	L_3	L_4	L_{Fe}
MSS202A-xxxx-FA-NOCN-NNNN MRS202A-1N-0096-NNNN	215	$187_{-0.5}$	125	62	150
MSS202B-xxxx-FA-NOCN-NNNN MRS202B-1N-0096-NNNN	265	$237_{-0.5}$	167	70	200
MSS202D-xxxx-FA-NOCN-NNNN MRS202D-1N-0096-NNNN	315	$287_{-0.5}$	207	80	250
MSS202F-xxxx-FA-NOCN-NNNN MRS202F-1N-0096-NNNN	415	$387_{-0.5}$	287	100	350

106-0446-3001-02.tif

Fig. 5-13: MBS202 with Axial Cooling Connection and Rotor Design “1N”

MBS202 with Axial Cooling Connection and Rotor Design “2N”

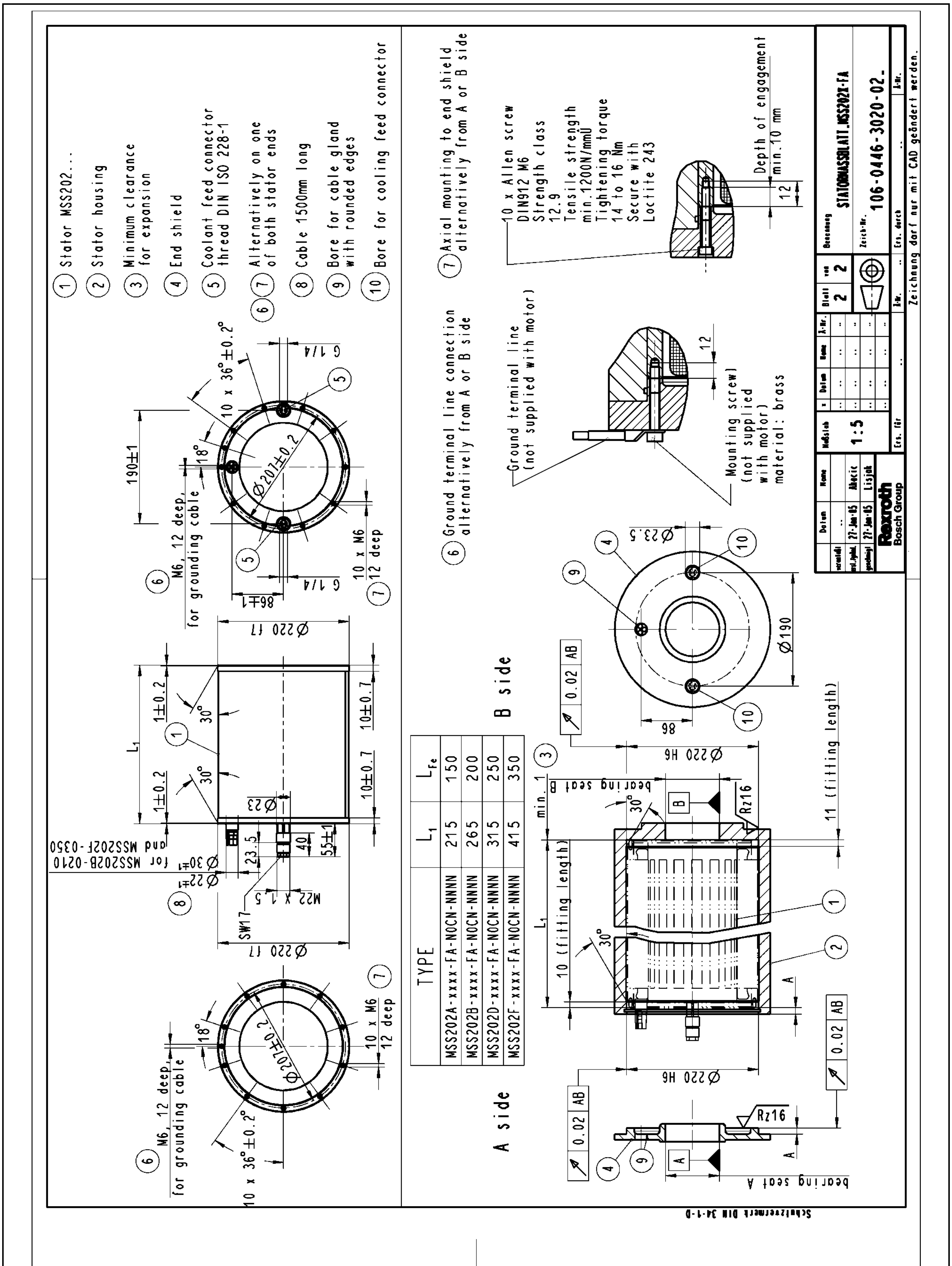


TYPE	L_1	L_2	L_3	L_{Fe}
MSS202A-xxxx-FA-NOCN-NNNN MRS202A-2N-0085-NNNN	215	$187_{-0.5}$	99	150
MSS202B-xxxx-FA-NOCN-NNNN MRS202B-2N-0085-NNNN	265	$237_{-0.5}$	149	200
MSS202D-xxxx-FA-NOCN-NNNN MRS202D-2N-0085-NNNN	315	$287_{-0.5}$	199	250
MSS202F-xxxx-FA-NOCN-NNNN MRS202F-2N-0085-NNNN	415	$387_{-0.5}$	299	350

106-0446-3002-02.tif

Fig. 5-14: MBS202 with Axial Cooling Connection and Rotor Design “2N”

MSS202, axial cooling connection

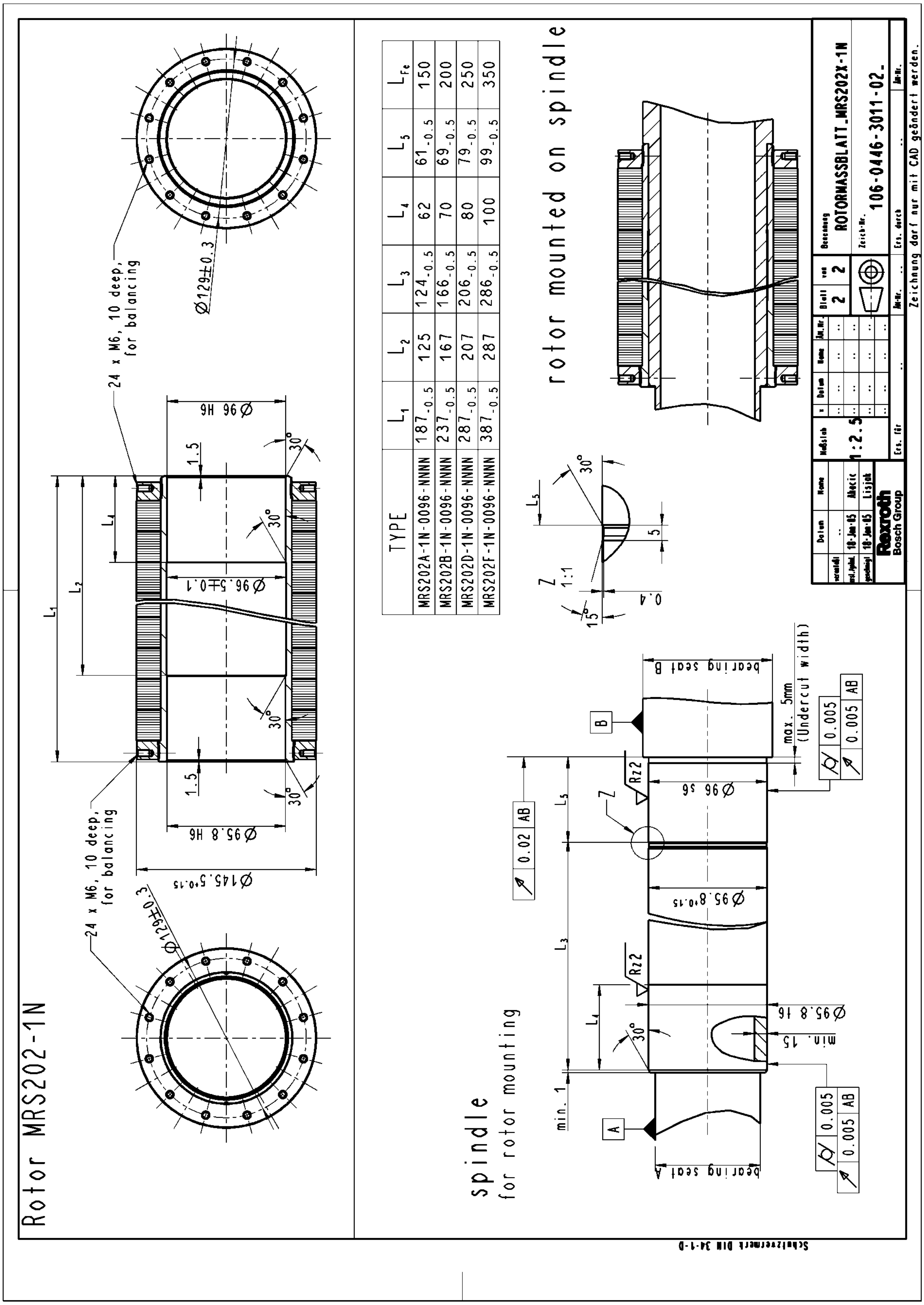


TYPE	L_1	L_{Fe}
MSS202A-xxxx-FA-NOCN-NNNN	215	150
MSS202B-xxxx-FA-NOCN-NNNN	265	200
MSS202D-xxxx-FA-NOCN-NNNN	315	250
MSS202F-xxxx-FA-NOCN-NNNN	415	350

106-0446-3020-02.tif

Fig. 5-15: MSS202, axial cooling connection

MRS202 with 1N Design (Smooth Hole)

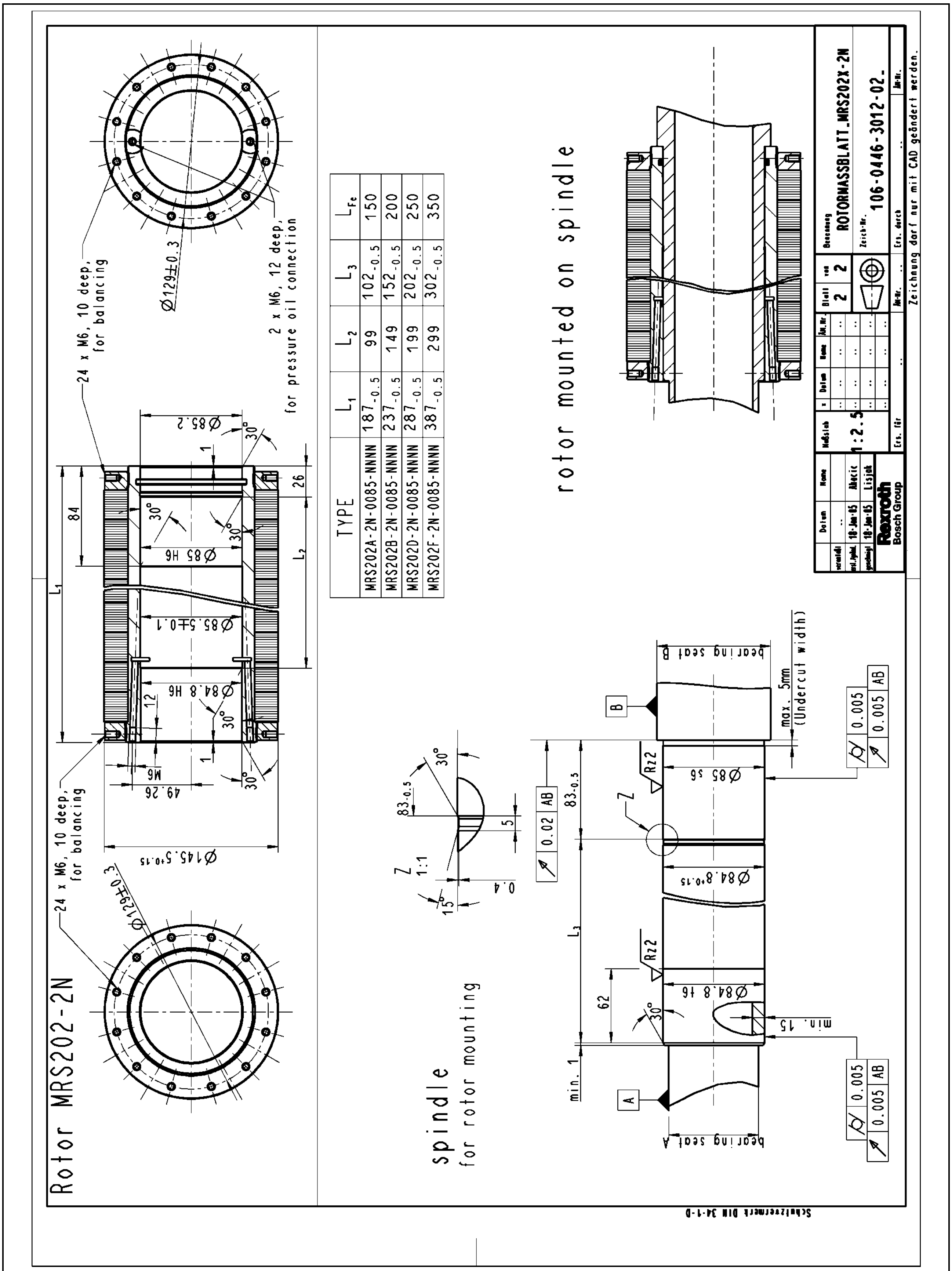


TYPE	L_1	L_2	L_3	L_4	L_5	L_{Fe}
MRS202A-1N-0096-NNNN	$187_{-0.5}$	125	$124_{-0.5}$	62	$61_{-0.5}$	150
MRS202B-1N-0096-NNNN	$237_{-0.5}$	167	$166_{-0.5}$	70	$69_{-0.5}$	200
MRS202D-1N-0096-NNNN	$287_{-0.5}$	207	$206_{-0.5}$	80	$79_{-0.5}$	250
MRS202F-1N-0096-NNNN	$387_{-0.5}$	287	$286_{-0.5}$	100	$99_{-0.5}$	350

106-0446-3011-02.TIF

Fig. 5-16: MRS202 in design 1N

MRS202 with 2N Design (Step Interference Fit)



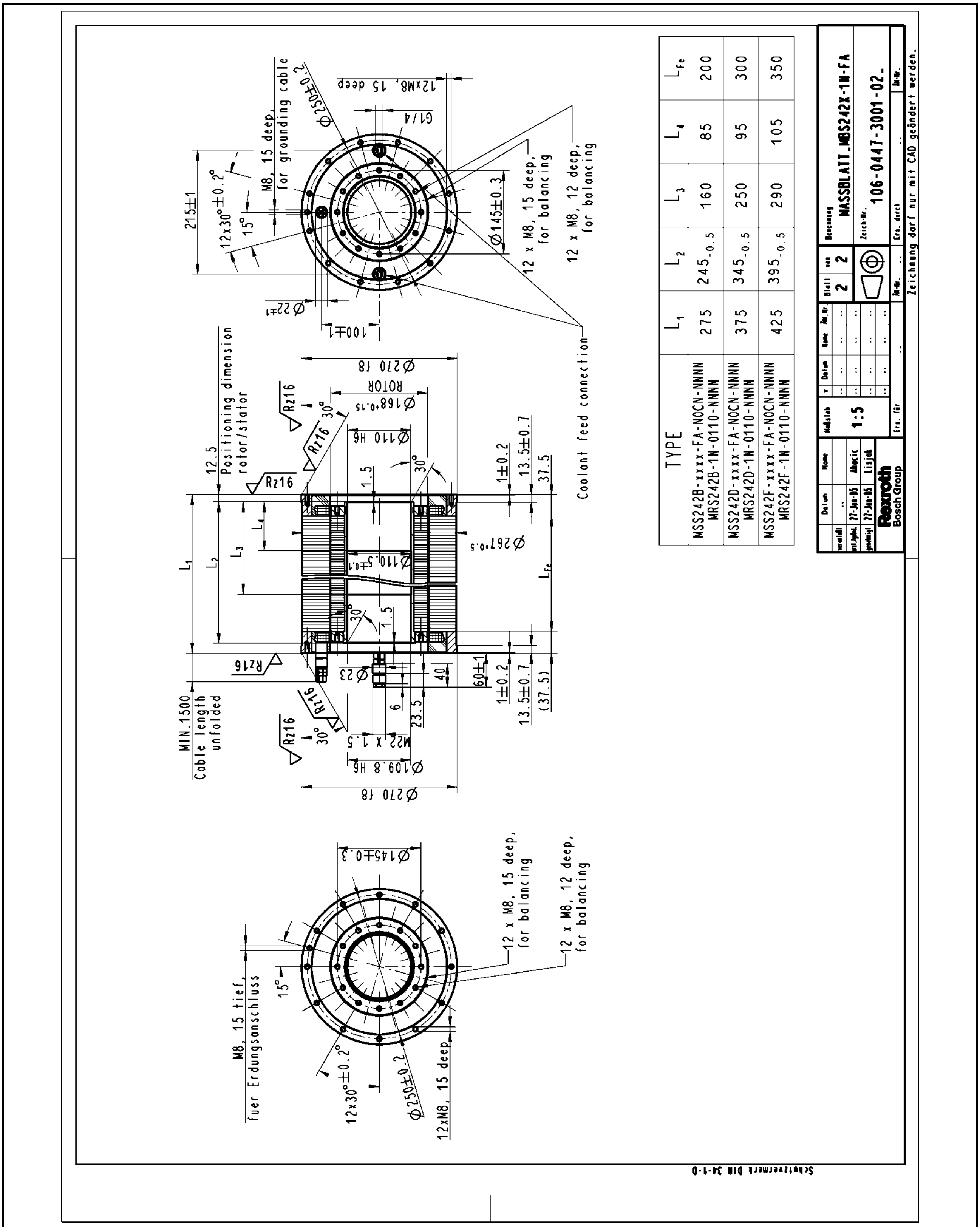
TYPE	L_1	L_2	L_3	L_{Fe}
MRS202A-2N-0085-NNNN	$187_{-0.5}$	99	$102_{-0.5}$	150
MRS202B-2N-0085-NNNN	$237_{-0.5}$	149	$152_{-0.5}$	200
MRS202D-2N-0085-NNNN	$287_{-0.5}$	199	$202_{-0.5}$	250
MRS202F-2N-0085-NNNN	$387_{-0.5}$	299	$302_{-0.5}$	350

106-0446-3012-02.tif

Fig. 5-17: MRS202 in design 2N

5.4 Size 242

MBS242 with Axial Cooling Connection and Rotor Design “1N”

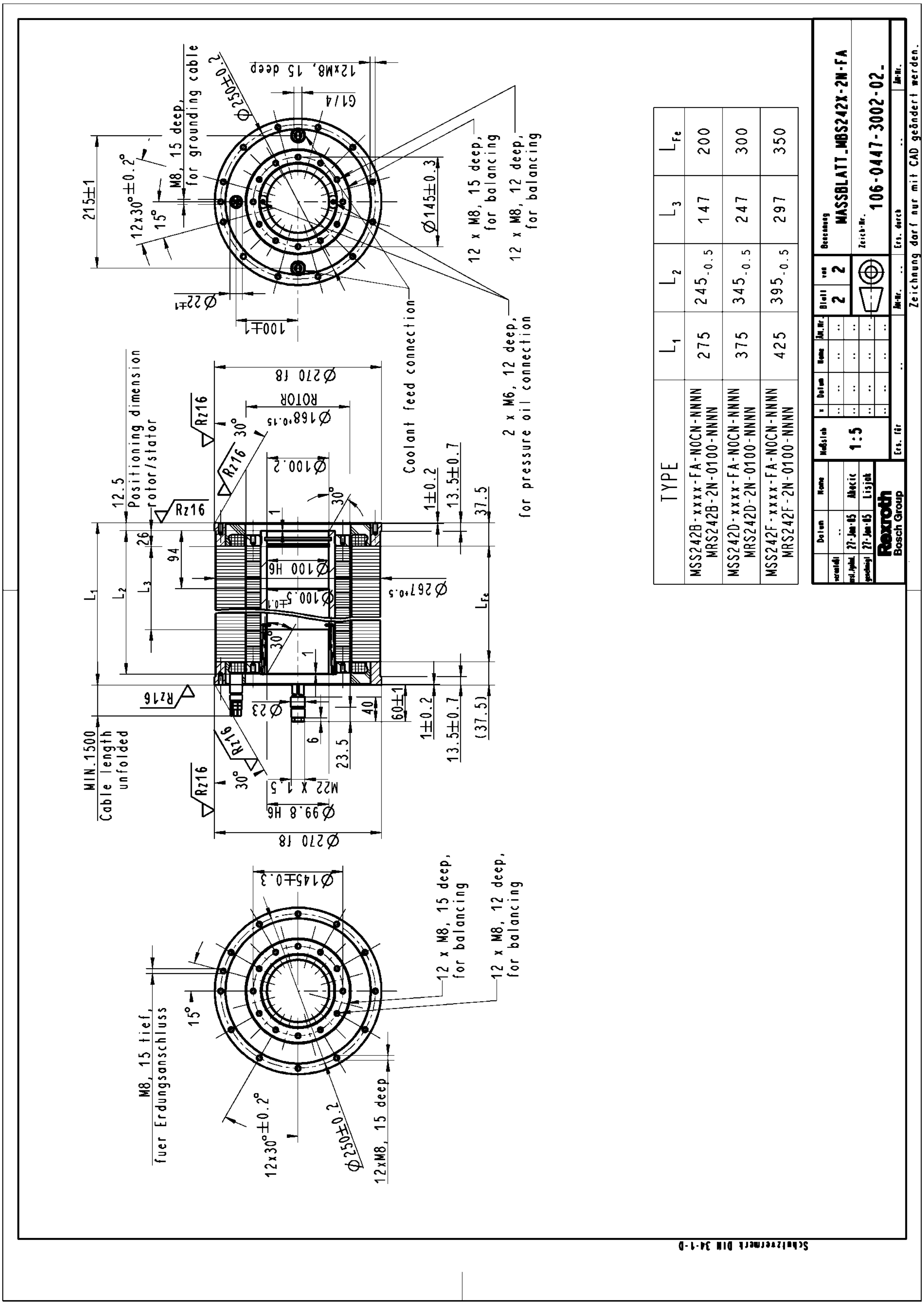


TYPE	L_1	L_2	L_3	L_4	L_{Fe}
MSS242B-xxxx-FA-N0CN-NNNN MRS242B-1N-0110-NNNN	275	$245_{-0.5}$	160	85	200
MSS242D-xxxx-FA-N0CN-NNNN MRS242D-1N-0110-NNNN	375	$345_{-0.5}$	250	95	300
MSS242F-xxxx-FA-N0CN-NNNN MRS242F-1N-0110-NNNN	425	$395_{-0.5}$	290	105	350

106-0447-3001-02.TIF

Fig. 5-18: MBS242 with Axial Cooling Connection and Rotor Design “1N”

MBS242 with Axial Cooling Connection and Rotor Design “2N”

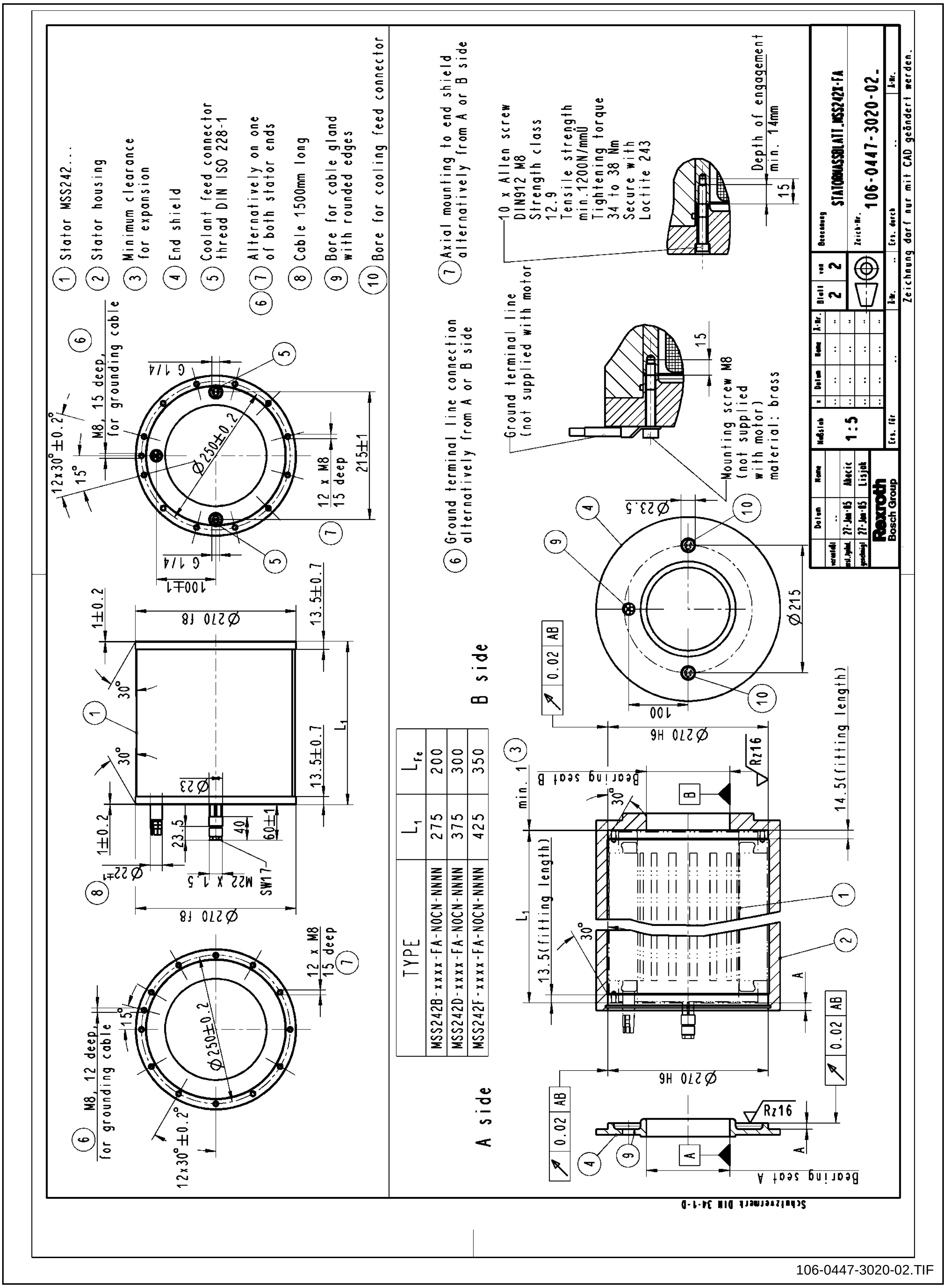


TYPE	L_1	L_2	L_3	L_{Fe}
MSS242B-xxxx-FA-N0CN-NNNN MRS242B-2N-0100-NNNN	275	$245_{-0.5}$	147	200
MSS242D-xxxx-FA-N0CN-NNNN MRS242D-2N-0100-NNNN	375	$345_{-0.5}$	247	300
MSS242F-xxxx-FA-N0CN-NNNN MRS242F-2N-0100-NNNN	425	$395_{-0.5}$	297	350

106-0447-3002-02.TIF

Fig. 5-19: MBS242 with Axial Cooling Connection and Rotor Design “2N”

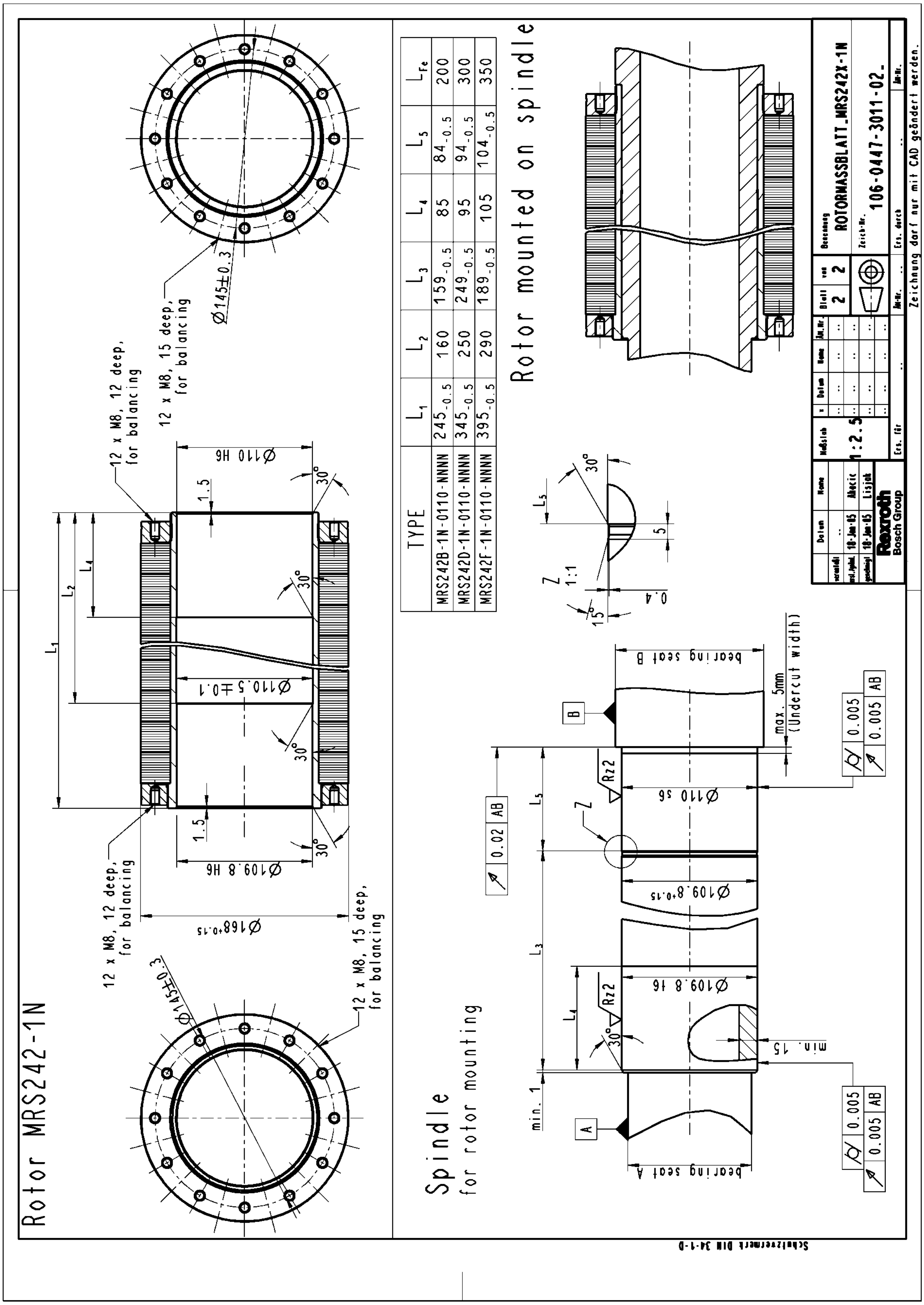
MSS242, axial cooling connection



106-0447-3020-02.TIF

Fig. 5-20: MSS242, axial cooling connection

MRS242 in design 1N

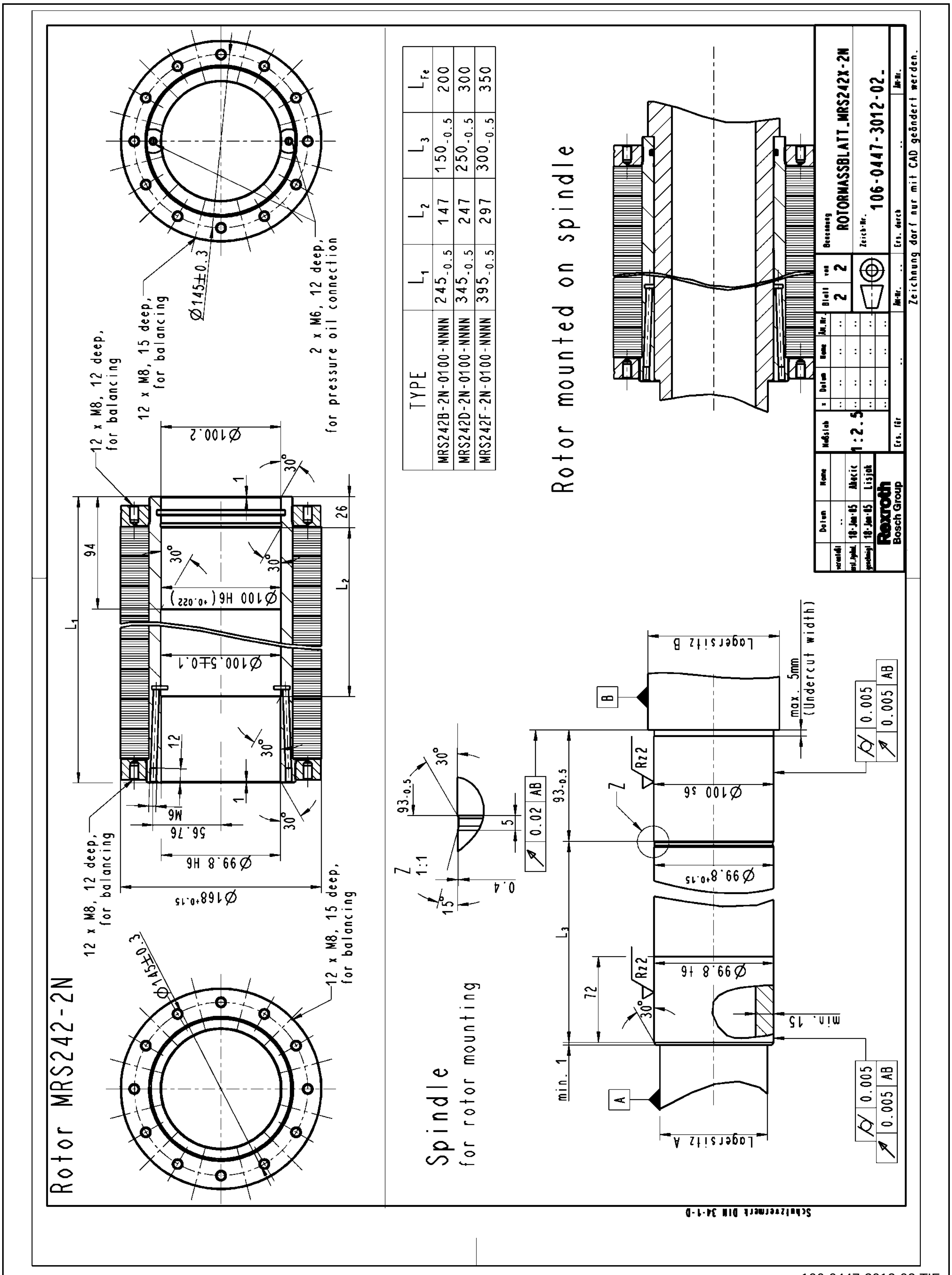


TYPE	L_1	L_2	L_3	L_4	L_5	L_{Fe}
MRS242B-1N-0110-NNNN	$245_{-0.5}$	160	$159_{-0.5}$	85	$84_{-0.5}$	200
MRS242D-1N-0110-NNNN	$345_{-0.5}$	250	$249_{-0.5}$	95	$94_{-0.5}$	300
MRS242F-1N-0110-NNNN	$395_{-0.5}$	290	$189_{-0.5}$	105	$104_{-0.5}$	350

106-0447-3011-02.TIF

Fig. 5-21: MRS242 in design 1N

MRS242 in design 2N

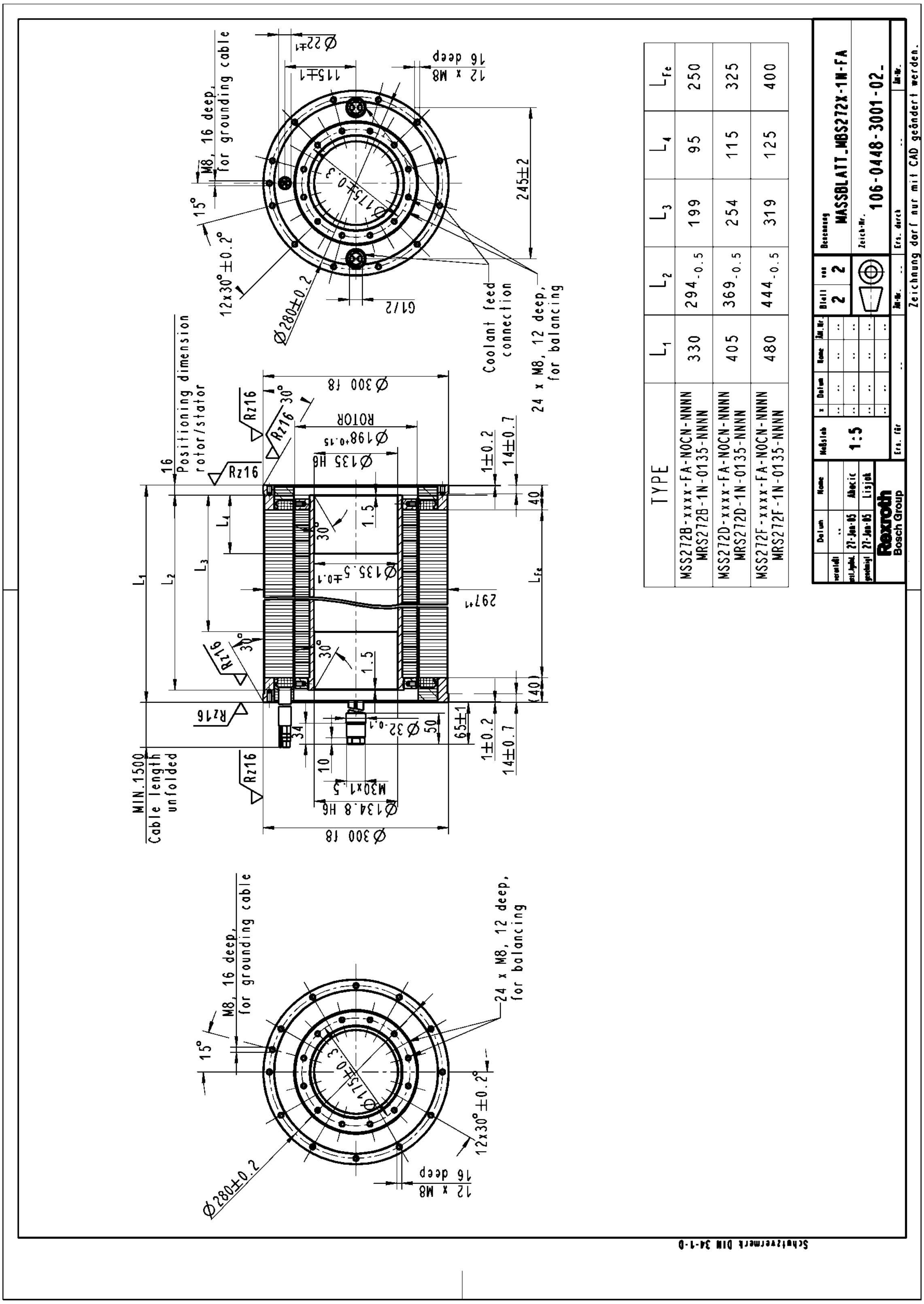


106-0447-3012-02.TIF

Fig. 5-22: MRS242 in design 2N

5.5 Size 272

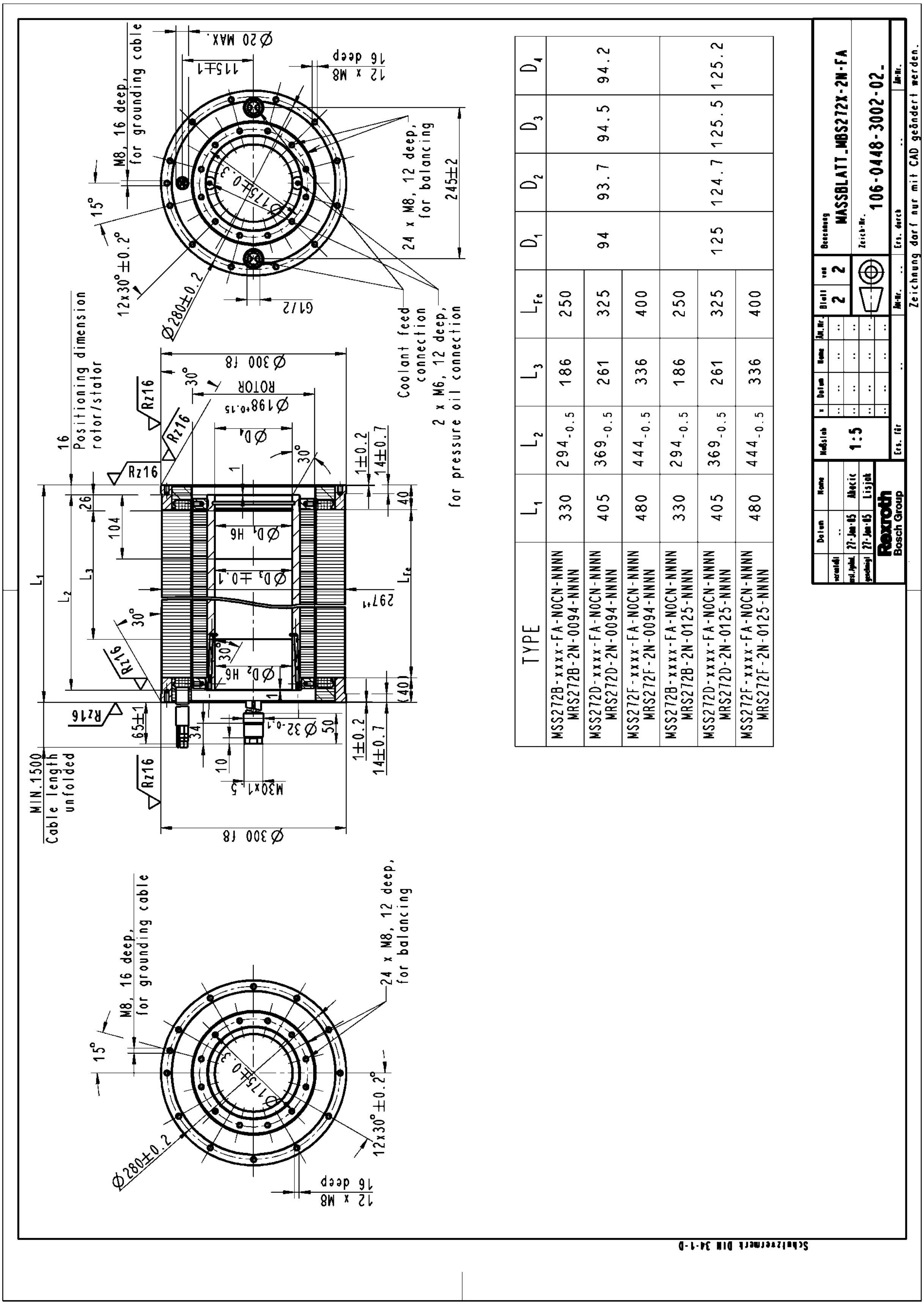
MBS272 with Axial Cooling Connection and Rotor Design “1N”



106-0448-3001-02.tif

Fig. 5-23: MBS272 with Axial Cooling Connection and Rotor Design “1N”

MBS272 with Axial Cooling Connection and Rotor Design “2N”

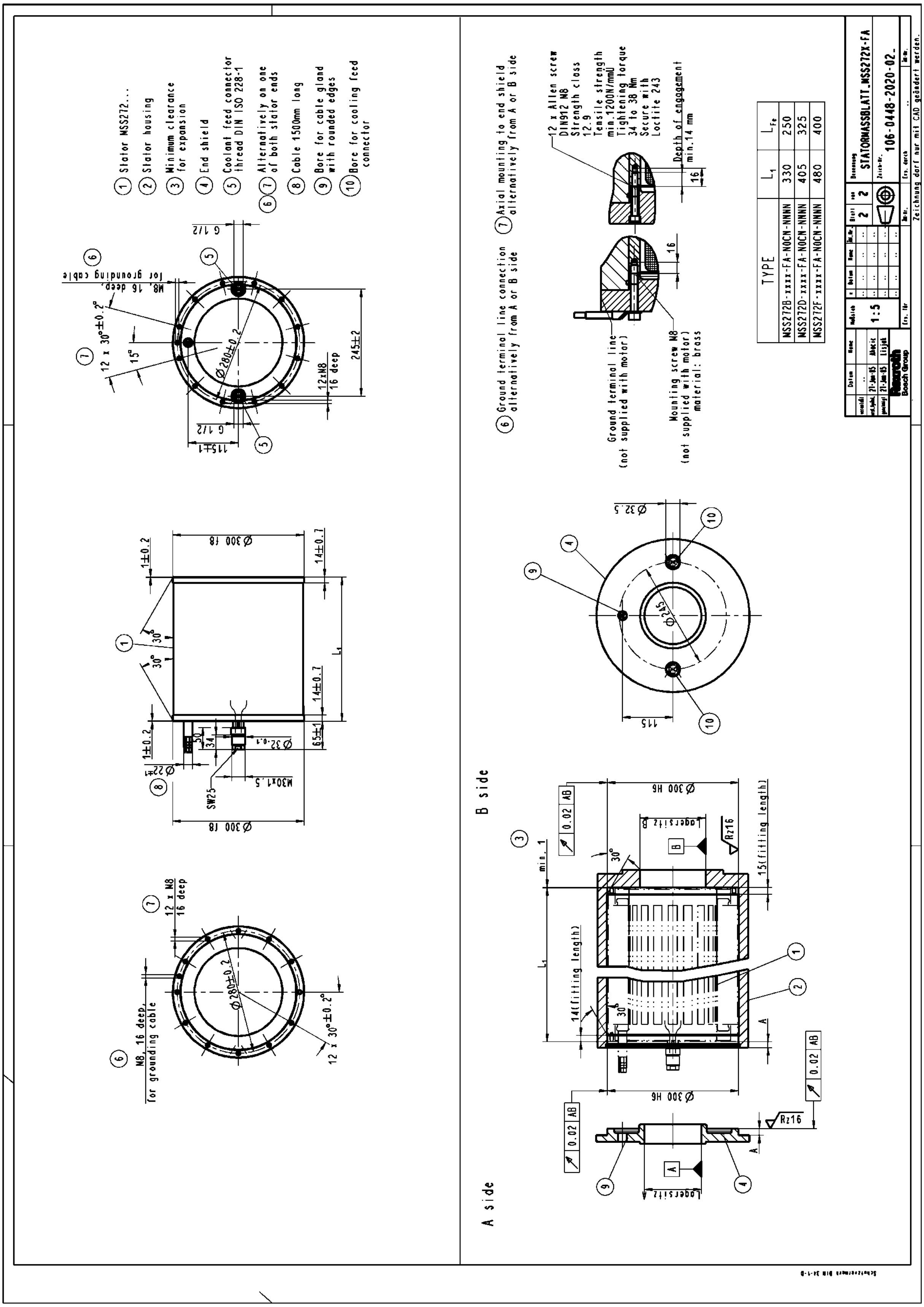


TYPE	L_1	L_2	L_3	L_{Fe}	D_1	D_2	D_3	D_4
MSS272B-xxxx-FA-N0CN-NNNN MRS272B-2N-0094-NNNN	330	$294_{-0.5}$	186	250	94	93.7	94.5	94.2
MSS272D-xxxx-FA-N0CN-NNNN MRS272D-2N-0094-NNNN	405	$369_{-0.5}$	261	325				
MSS272F-xxxx-FA-N0CN-NNNN MRS272F-2N-0094-NNNN	480	$444_{-0.5}$	336	400				
MSS272B-xxxx-FA-N0CN-NNNN MRS272B-2N-0125-NNNN	330	$294_{-0.5}$	186	250	125	124.7	125.5	125.2
MSS272D-xxxx-FA-N0CN-NNNN MRS272D-2N-0125-NNNN	405	$369_{-0.5}$	261	325				
MSS272F-xxxx-FA-N0CN-NNNN MRS272F-2N-0125-NNNN	480	$444_{-0.5}$	336	400				

106-0448-3002-02.tif

Fig. 5-24: MBS272 with Axial Cooling Connection and Rotor Design “2N”

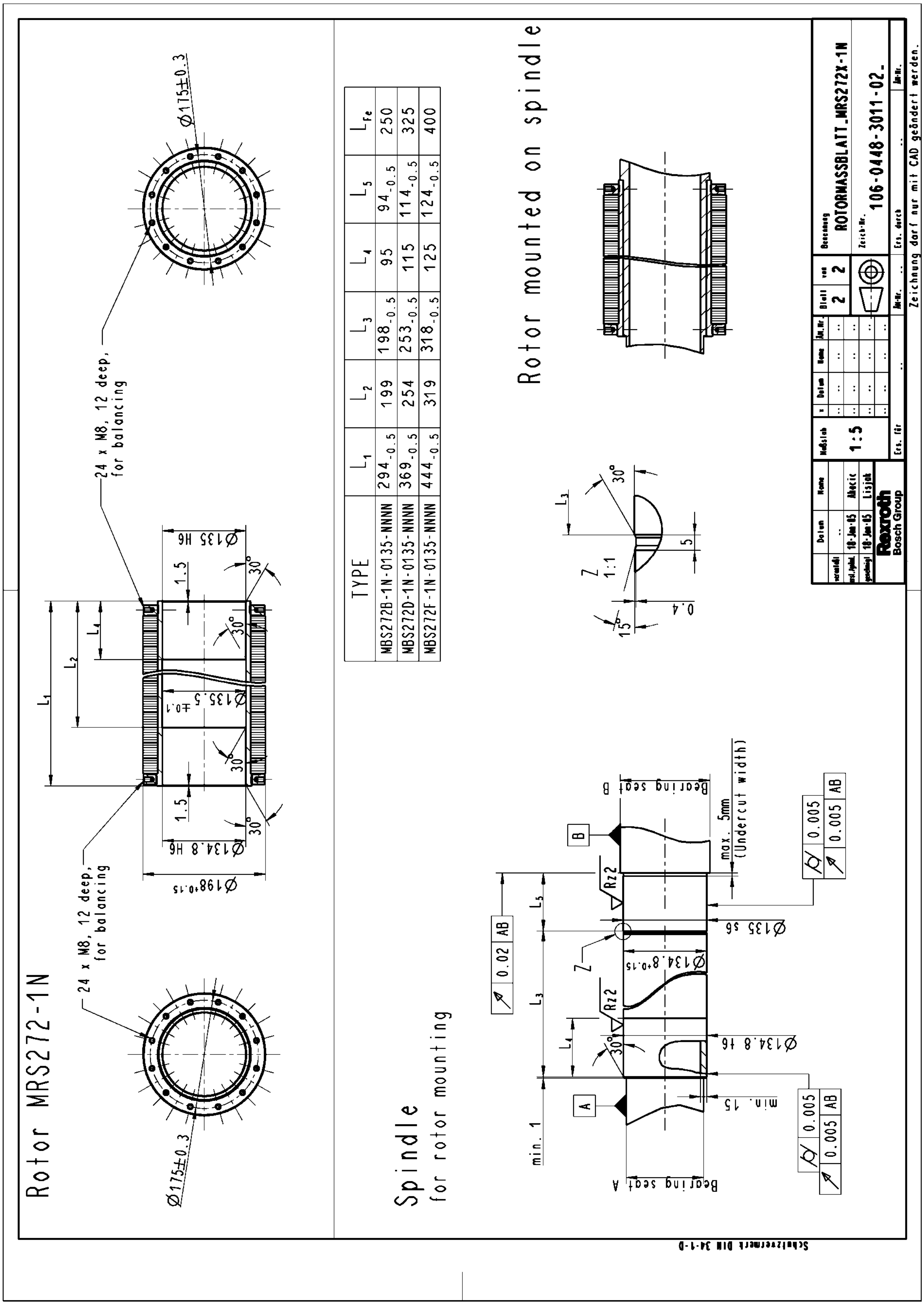
MSS272, axial cooling connection



106-0448-2020-02.tif

Fig. 5-25: MSS272, axial cooling connection

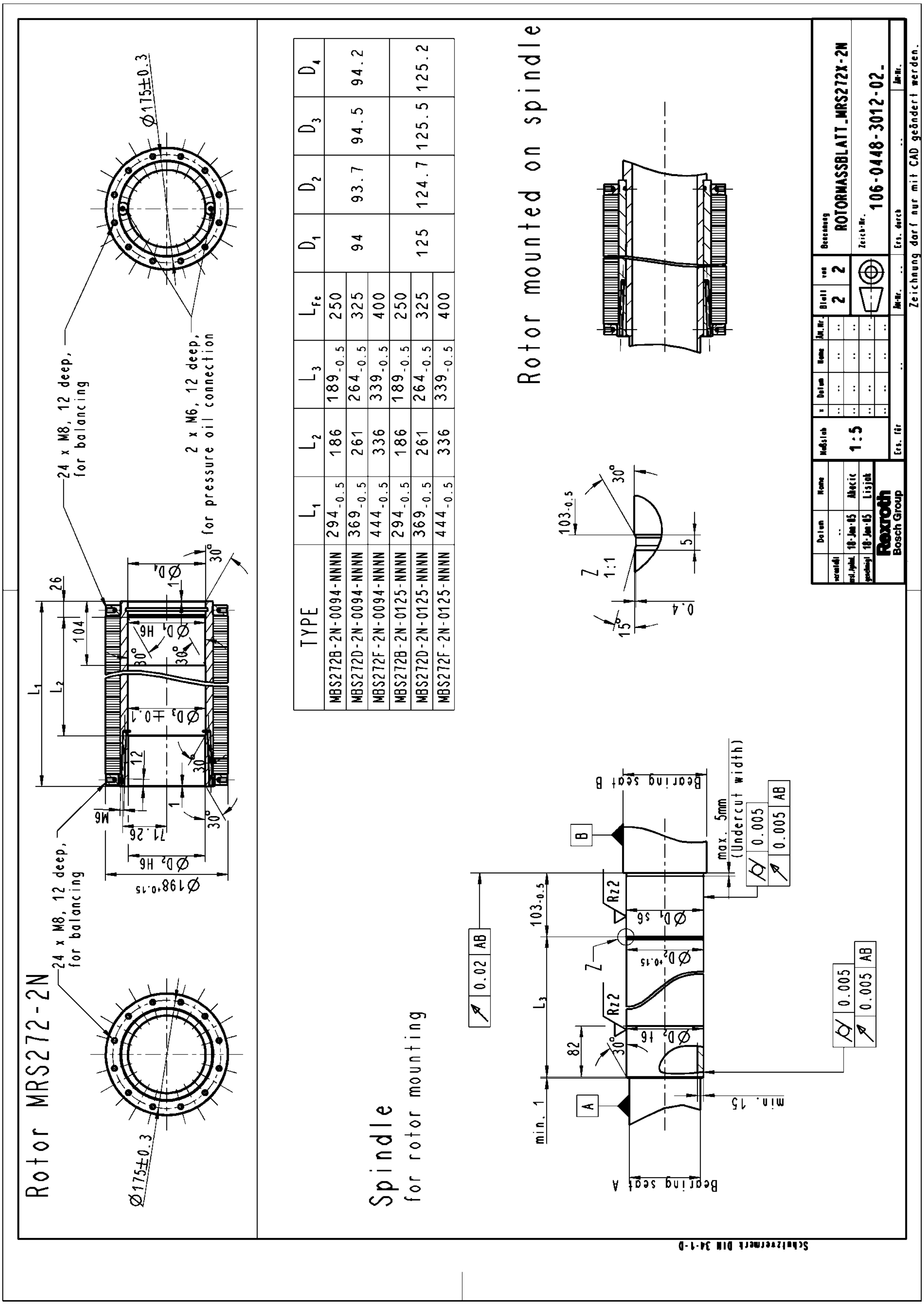
MRS272 in design 1N



106-0448-3011-02.TIF

Fig. 5-26: MRS272 in design 1N

MRS272 in design 2N



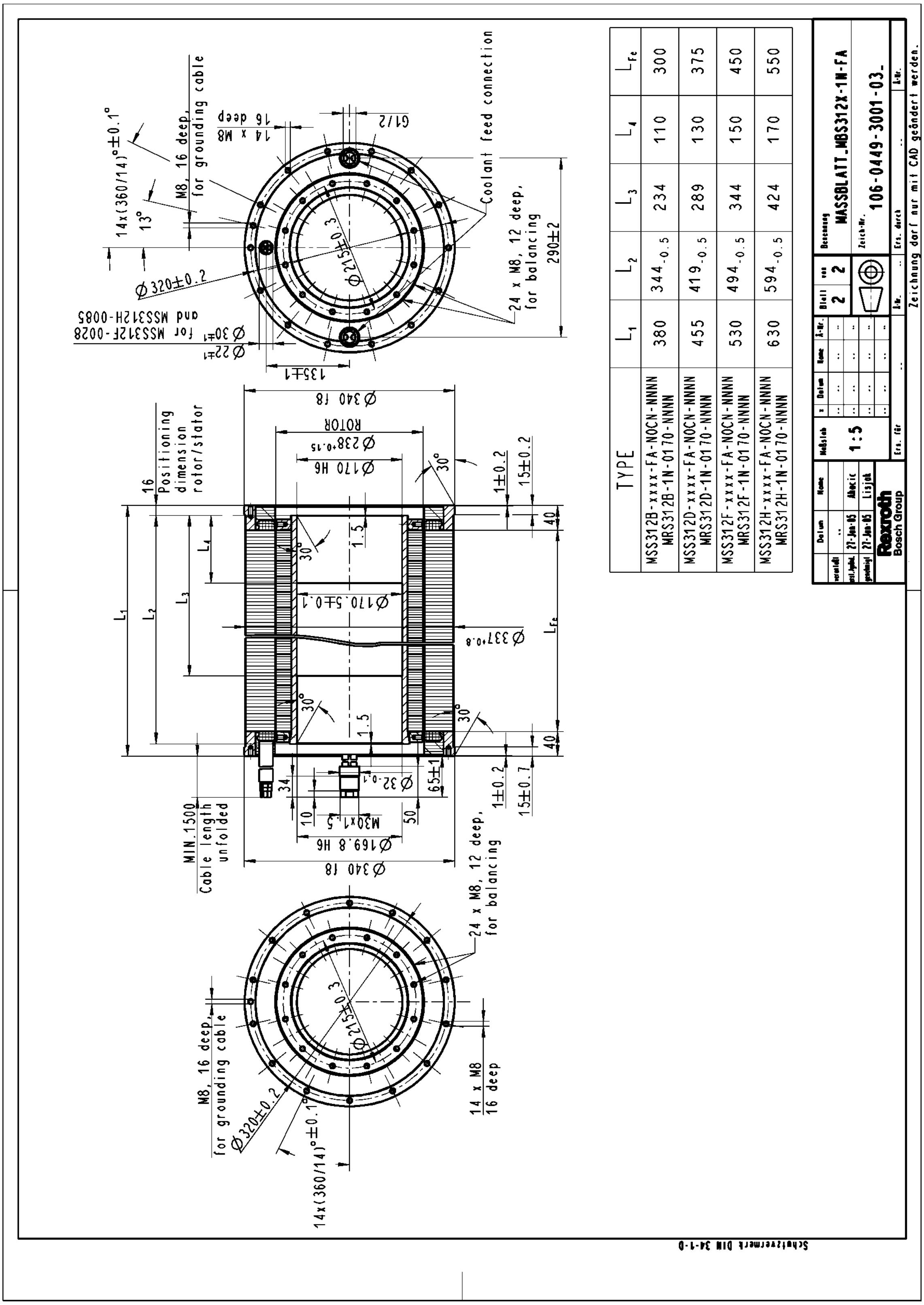
TYPE	L_1	L_2	L_3	L_{Fe}	D_1	D_2	D_3	D_4
MBS272B-2N-0094-NNNN	$294_{-0.5}$	186	$189_{-0.5}$	250	94	93.7	94.5	94.2
MBS272D-2N-0094-NNNN	$369_{-0.5}$	261	$264_{-0.5}$	325				
MBS272F-2N-0094-NNNN	$444_{-0.5}$	336	$339_{-0.5}$	400				
MBS272B-2N-0125-NNNN	$294_{-0.5}$	186	$189_{-0.5}$	250	125	124.7	125.5	125.2
MBS272D-2N-0125-NNNN	$369_{-0.5}$	261	$264_{-0.5}$	325				
MBS272F-2N-0125-NNNN	$444_{-0.5}$	336	$339_{-0.5}$	400				

106-0448-3012-02.tif

Fig. 5-27: MRS272 in design 2N

5.6 Dimension Sheet Size 312

MBS312 with Axial Cooling Connection and Rotor Design “1N”

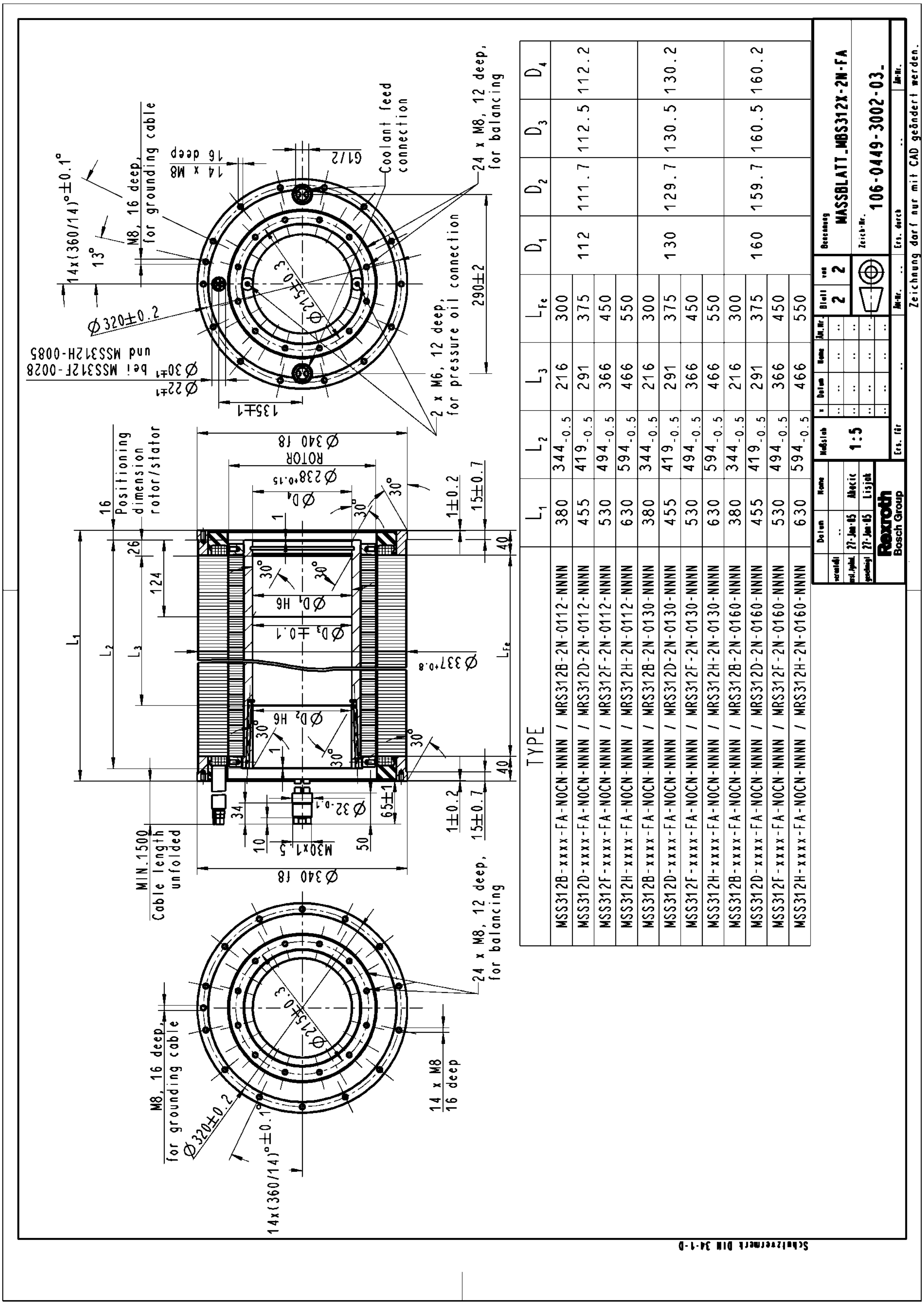


TYPE	L_1	L_2	L_3	L_4	L_{Fe}
MSS312B-xxxx-FA-NOCN-NNNN MRS312B-1N-0170-NNNN	380	$344_{-0.5}$	234	110	300
MSS312D-xxxx-FA-NOCN-NNNN MRS312D-1N-0170-NNNN	455	$419_{-0.5}$	289	130	375
MSS312F-xxxx-FA-NOCN-NNNN MRS312F-1N-0170-NNNN	530	$494_{-0.5}$	344	150	450
MSS312H-xxxx-FA-NOCN-NNNN MRS312H-1N-0170-NNNN	630	$594_{-0.5}$	424	170	550

106-0449-3001-03.tif

Fig. 5-28: MBS312 with Axial Cooling Connection and Rotor Design “1N”

MBS312 with Axial Cooling Connection and Rotor Design “2N”

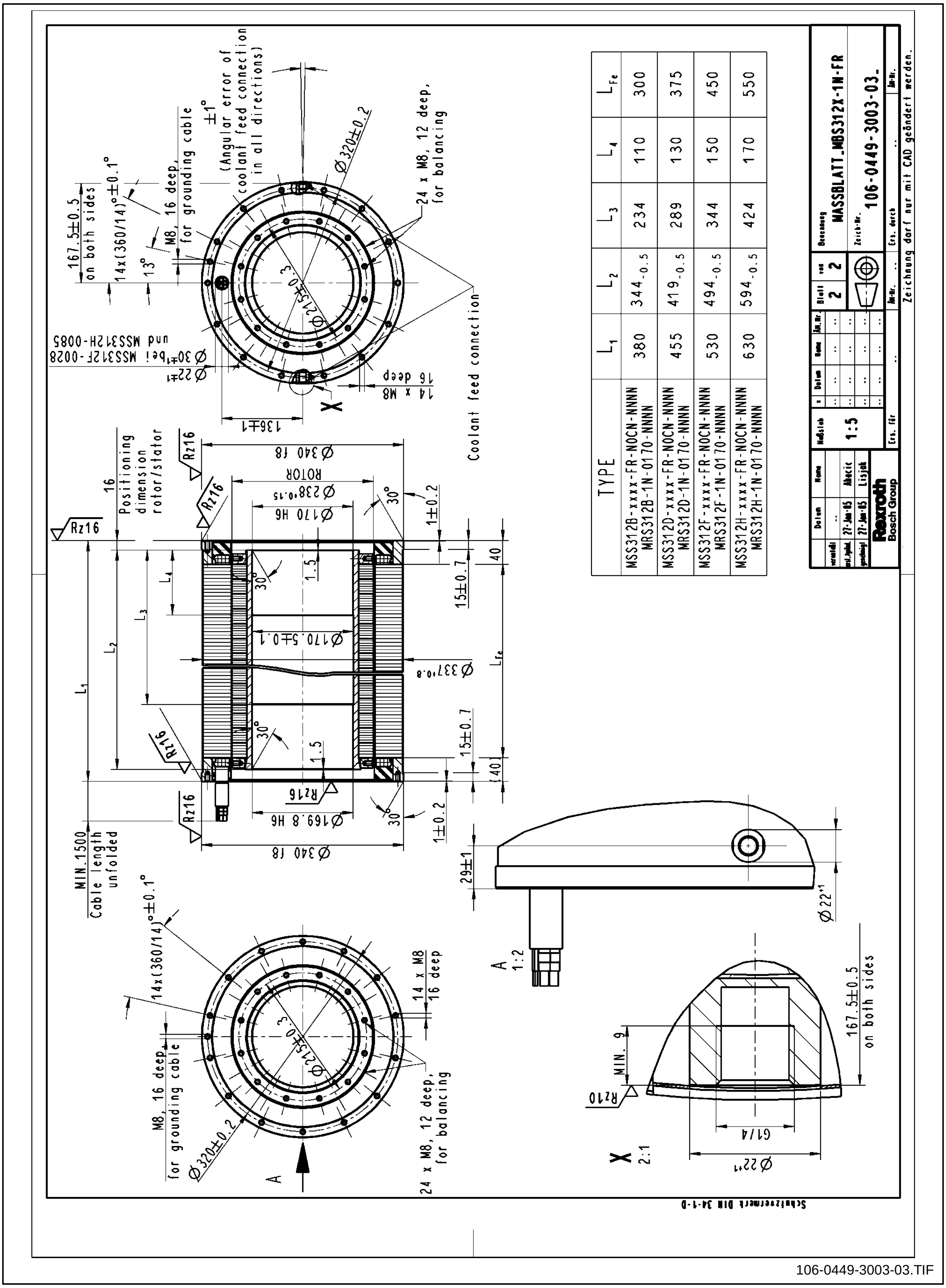


TYPE	L_1	L_2	L_3	L_{Fe}	D_1	D_2	D_3	D_4
MSS312B-xxxx-FA-NOCN-NNNN / MRS312B-2N-0112-NNNN	380	$344_{-0.5}$	216	300	112	111.7	112.5	112.2
MSS312D-xxxx-FA-NOCN-NNNN / MRS312D-2N-0112-NNNN	455	$419_{-0.5}$	291	375				
MSS312F-xxxx-FA-NOCN-NNNN / MRS312F-2N-0112-NNNN	530	$494_{-0.5}$	366	450				
MSS312H-xxxx-FA-NOCN-NNNN / MRS312H-2N-0112-NNNN	630	$594_{-0.5}$	466	550				
MSS312B-xxxx-FA-NOCN-NNNN / MRS312B-2N-0130-NNNN	380	$344_{-0.5}$	216	300	130	129.7	130.5	130.2
MSS312D-xxxx-FA-NOCN-NNNN / MRS312D-2N-0130-NNNN	455	$419_{-0.5}$	291	375				
MSS312F-xxxx-FA-NOCN-NNNN / MRS312F-2N-0130-NNNN	530	$494_{-0.5}$	366	450				
MSS312H-xxxx-FA-NOCN-NNNN / MRS312H-2N-0130-NNNN	630	$594_{-0.5}$	466	550				
MSS312B-xxxx-FA-NOCN-NNNN / MRS312B-2N-0160-NNNN	380	$344_{-0.5}$	216	300	160	159.7	160.5	160.2
MSS312D-xxxx-FA-NOCN-NNNN / MRS312D-2N-0160-NNNN	455	$419_{-0.5}$	291	375				
MSS312F-xxxx-FA-NOCN-NNNN / MRS312F-2N-0160-NNNN	530	$494_{-0.5}$	366	450				
MSS312H-xxxx-FA-NOCN-NNNN / MRS312H-2N-0160-NNNN	630	$594_{-0.5}$	466	550				

106-0449-3002-03.tif

Fig. 5-29: MBS312 with Axial Cooling Connection and Rotor Design “2N”

MBS312 with Radial Cooling Connection and Rotor Design "1N"

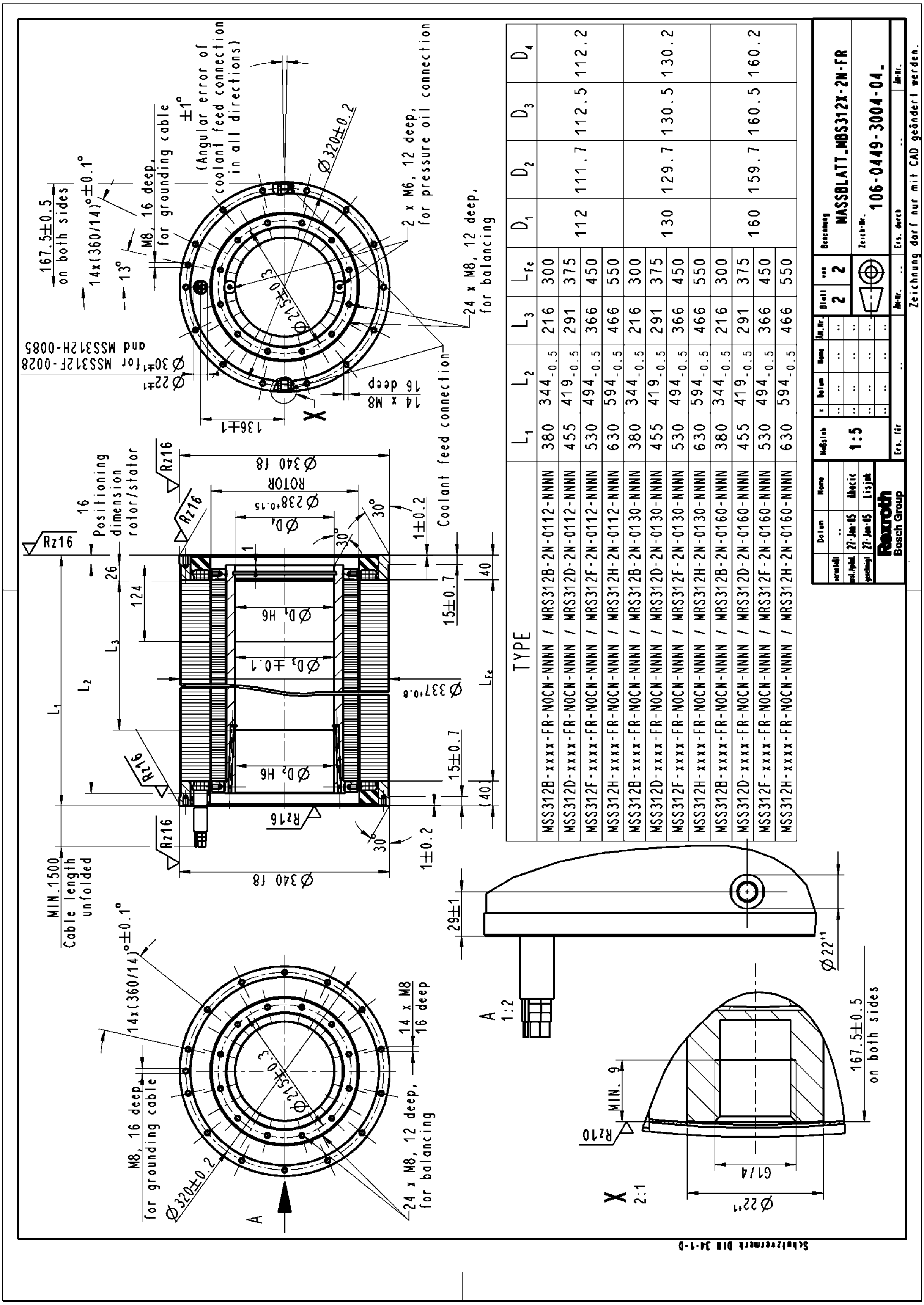


TYPE	L_1	L_2	L_3	L_4	L_{Fe}
MSS312B-xxxx-FR-N0CN-NNNN MRS312B-1N-0170-NNNN	380	$344_{-0.5}$	234	110	300
MSS312D-xxxx-FR-N0CN-NNNN MRS312D-1N-0170-NNNN	455	$419_{-0.5}$	289	130	375
MSS312F-xxxx-FR-N0CN-NNNN MRS312F-1N-0170-NNNN	530	$494_{-0.5}$	344	150	450
MSS312H-xxxx-FR-N0CN-NNNN MRS312H-1N-0170-NNNN	630	$594_{-0.5}$	424	170	550

106-0449-3003-03.TIF

Fig. 5-30: MBS312 with Radial Cooling Connection and Rotor Design "1N"

MBS312 with Radial Cooling Connection and Rotor Design “2N”

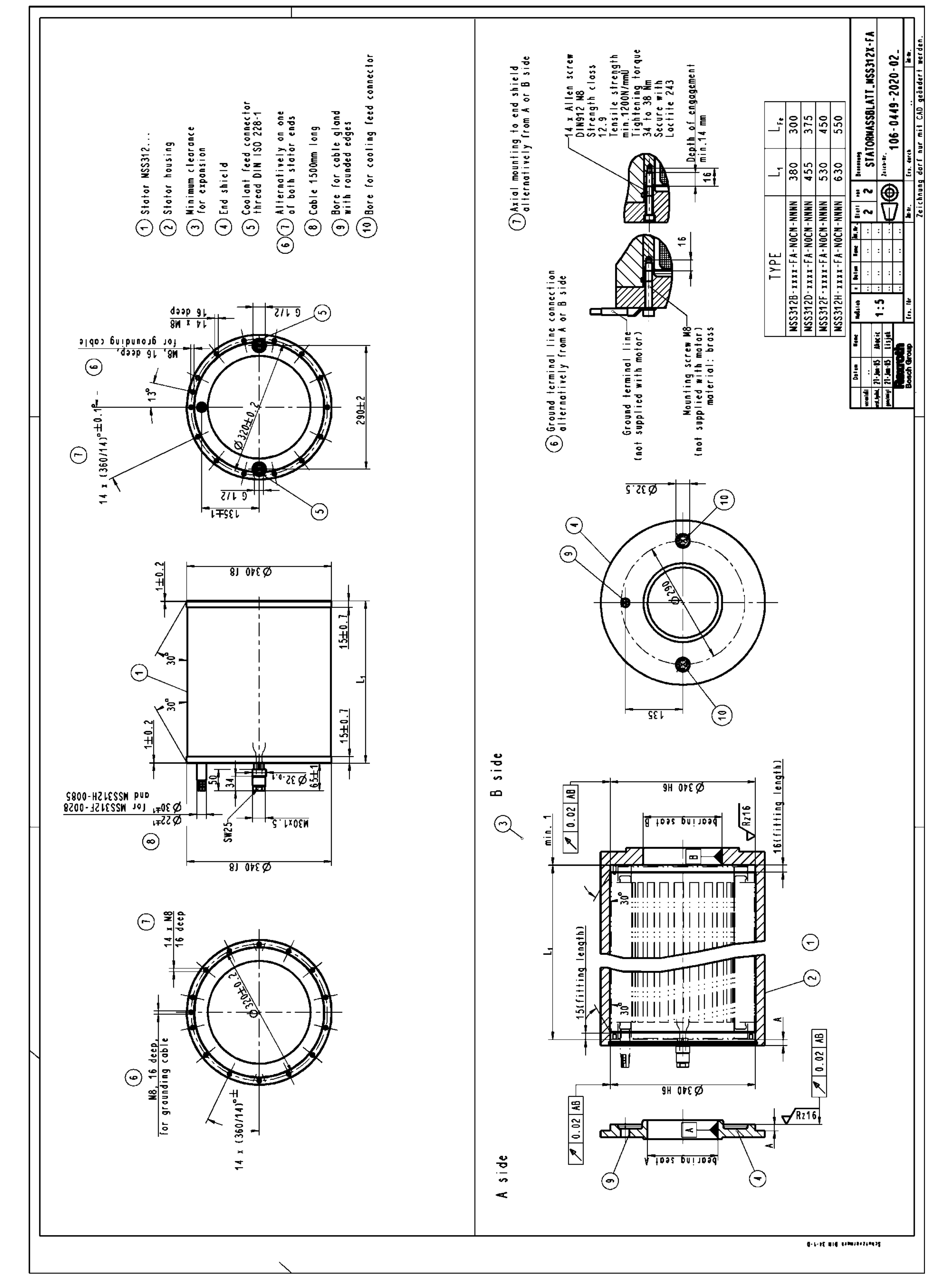


TYPE	L_1	L_2	L_3	L_{Fe}	D_1	D_2	D_3	D_4
MSS312B-xxxx-FR-N0CN-NNNN / MRS312B-2N-0112-NNNN	380	$344_{-0.5}$	216	300	112	111.7	112.5	112.2
MSS312D-xxxx-FR-N0CN-NNNN / MRS312D-2N-0112-NNNN	455	$419_{-0.5}$	291	375				
MSS312F-xxxx-FR-N0CN-NNNN / MRS312F-2N-0112-NNNN	530	$494_{-0.5}$	366	450				
MSS312H-xxxx-FR-N0CN-NNNN / MRS312H-2N-0112-NNNN	630	$594_{-0.5}$	466	550				
MSS312B-xxxx-FR-N0CN-NNNN / MRS312B-2N-0130-NNNN	380	$344_{-0.5}$	216	300	130	129.7	130.5	130.2
MSS312D-xxxx-FR-N0CN-NNNN / MRS312D-2N-0130-NNNN	455	$419_{-0.5}$	291	375				
MSS312F-xxxx-FR-N0CN-NNNN / MRS312F-2N-0130-NNNN	530	$494_{-0.5}$	366	450				
MSS312H-xxxx-FR-N0CN-NNNN / MRS312H-2N-0130-NNNN	630	$594_{-0.5}$	466	550				
MSS312B-xxxx-FR-N0CN-NNNN / MRS312B-2N-0160-NNNN	380	$344_{-0.5}$	216	300	160	159.7	160.5	160.2
MSS312D-xxxx-FR-N0CN-NNNN / MRS312D-2N-0160-NNNN	455	$419_{-0.5}$	291	375				
MSS312F-xxxx-FR-N0CN-NNNN / MRS312F-2N-0160-NNNN	530	$494_{-0.5}$	366	450				
MSS312H-xxxx-FR-N0CN-NNNN / MRS312H-2N-0160-NNNN	630	$594_{-0.5}$	466	550				

106-0449-3004-04.TIF

Fig. 5-31: MBS312 with Radial Cooling Connection and Rotor Design “2N”

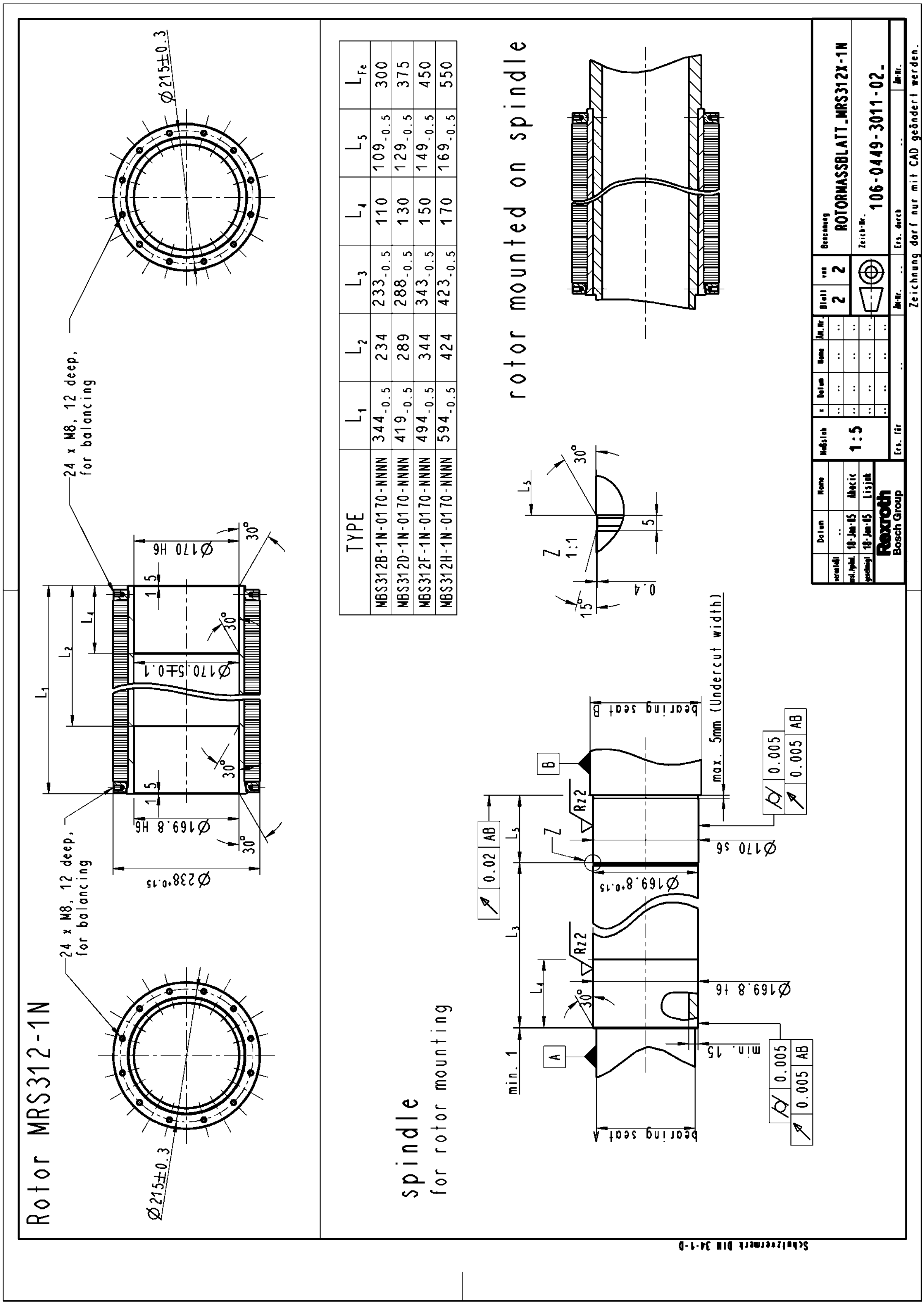
MSS312, axial cooling connection



106-0449-2020-02.tif

Fig. 5-32: MSS312, axial cooling connection

MRS312 in design 1N

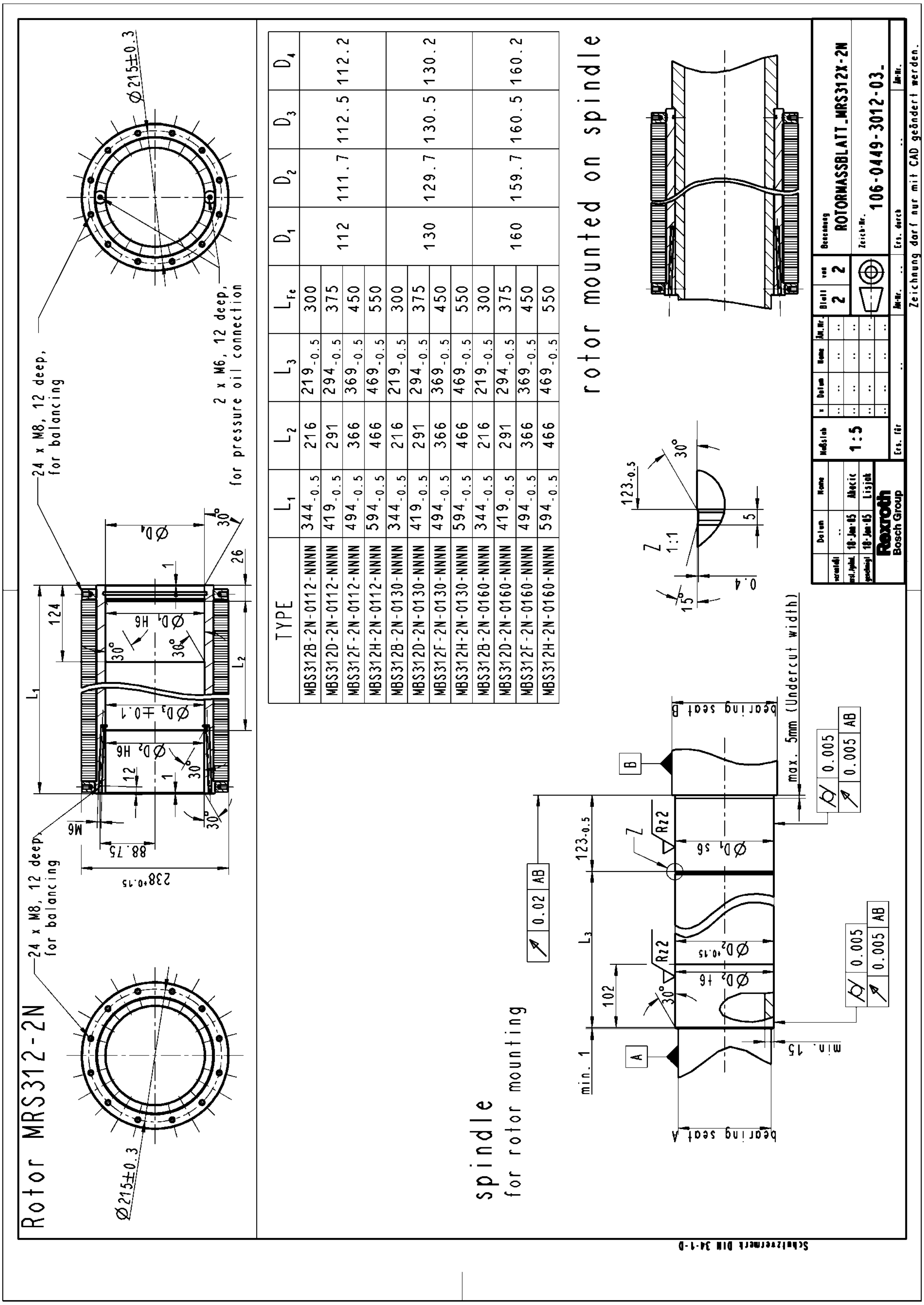


TYPE	L_1	L_2	L_3	L_4	L_5	L_{Fe}
MBS312B-1N-0170-NNNN	$344_{-0.5}$	234	$233_{-0.5}$	110	$109_{-0.5}$	300
MBS312D-1N-0170-NNNN	$419_{-0.5}$	289	$288_{-0.5}$	130	$129_{-0.5}$	375
MBS312F-1N-0170-NNNN	$494_{-0.5}$	344	$343_{-0.5}$	150	$149_{-0.5}$	450
MBS312H-1N-0170-NNNN	$594_{-0.5}$	424	$423_{-0.5}$	170	$169_{-0.5}$	550

106-0449-3011-02.TIF

Fig. 5-33: MRS312 in design 1N

MRS312 in design 2N



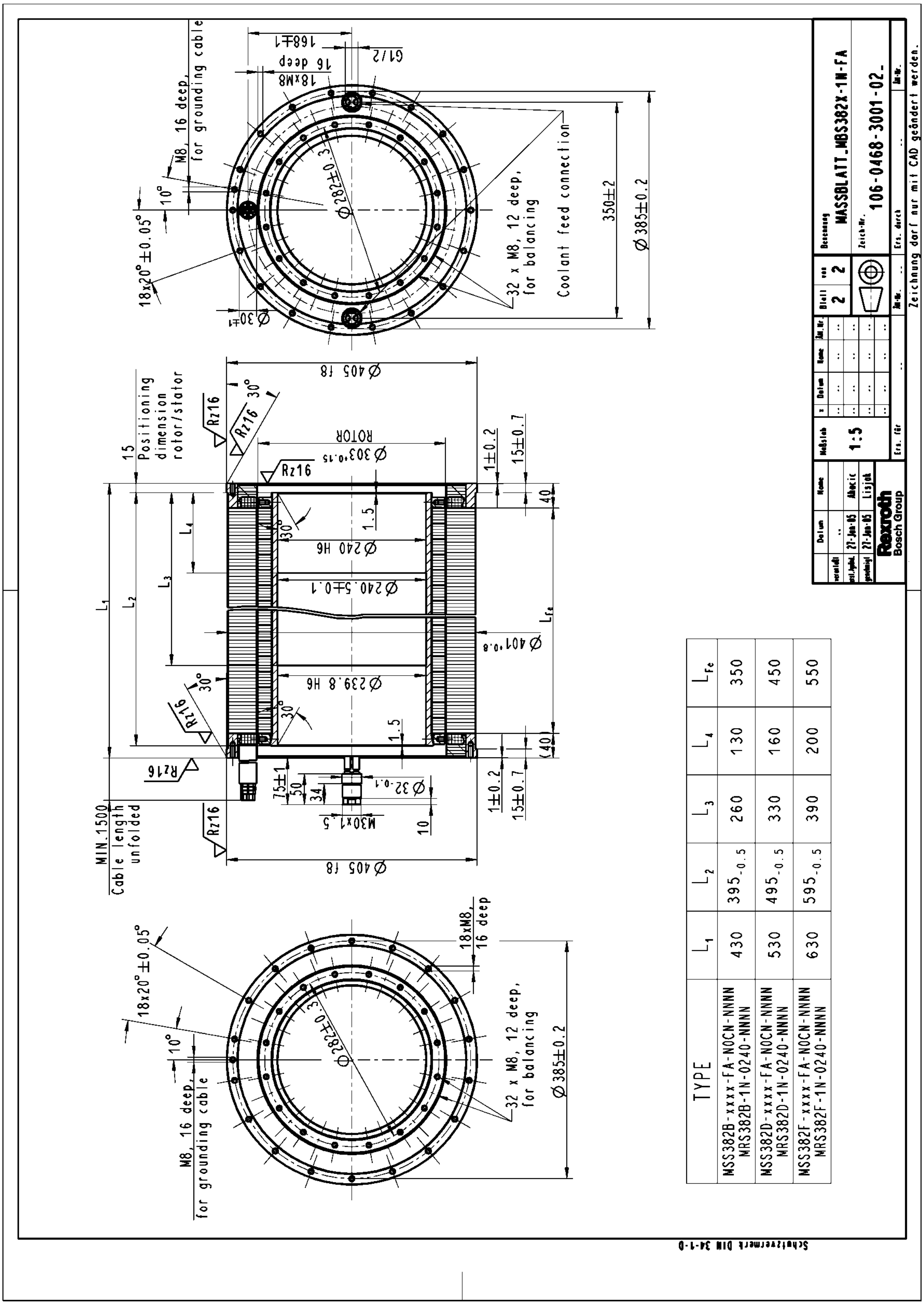
TYPE	L_1	L_2	L_3	L_{Fe}	D_1	D_2	D_3	D_4
MBS312B-2N-0112-NNNN	$344_{-0.5}$	216	$219_{-0.5}$	300	112	111.7	112.5	112.2
MBS312D-2N-0112-NNNN	$419_{-0.5}$	291	$294_{-0.5}$	375				
MBS312F-2N-0112-NNNN	$494_{-0.5}$	366	$369_{-0.5}$	450				
MBS312H-2N-0112-NNNN	$594_{-0.5}$	466	$469_{-0.5}$	550				
MBS312B-2N-0130-NNNN	$344_{-0.5}$	216	$219_{-0.5}$	300	130	129.7	130.5	130.2
MBS312D-2N-0130-NNNN	$419_{-0.5}$	291	$294_{-0.5}$	375				
MBS312F-2N-0130-NNNN	$494_{-0.5}$	366	$369_{-0.5}$	450				
MBS312H-2N-0130-NNNN	$594_{-0.5}$	466	$469_{-0.5}$	550				
MBS312B-2N-0160-NNNN	$344_{-0.5}$	216	$219_{-0.5}$	300	160	159.7	160.5	160.2
MBS312D-2N-0160-NNNN	$419_{-0.5}$	291	$294_{-0.5}$	375				
MBS312F-2N-0160-NNNN	$494_{-0.5}$	366	$369_{-0.5}$	450				
MBS312H-2N-0160-NNNN	$594_{-0.5}$	466	$469_{-0.5}$	550				

106-0449-3012-03.tif

Fig. 5-34: MRS312 in design 2N

5.7 Size 382

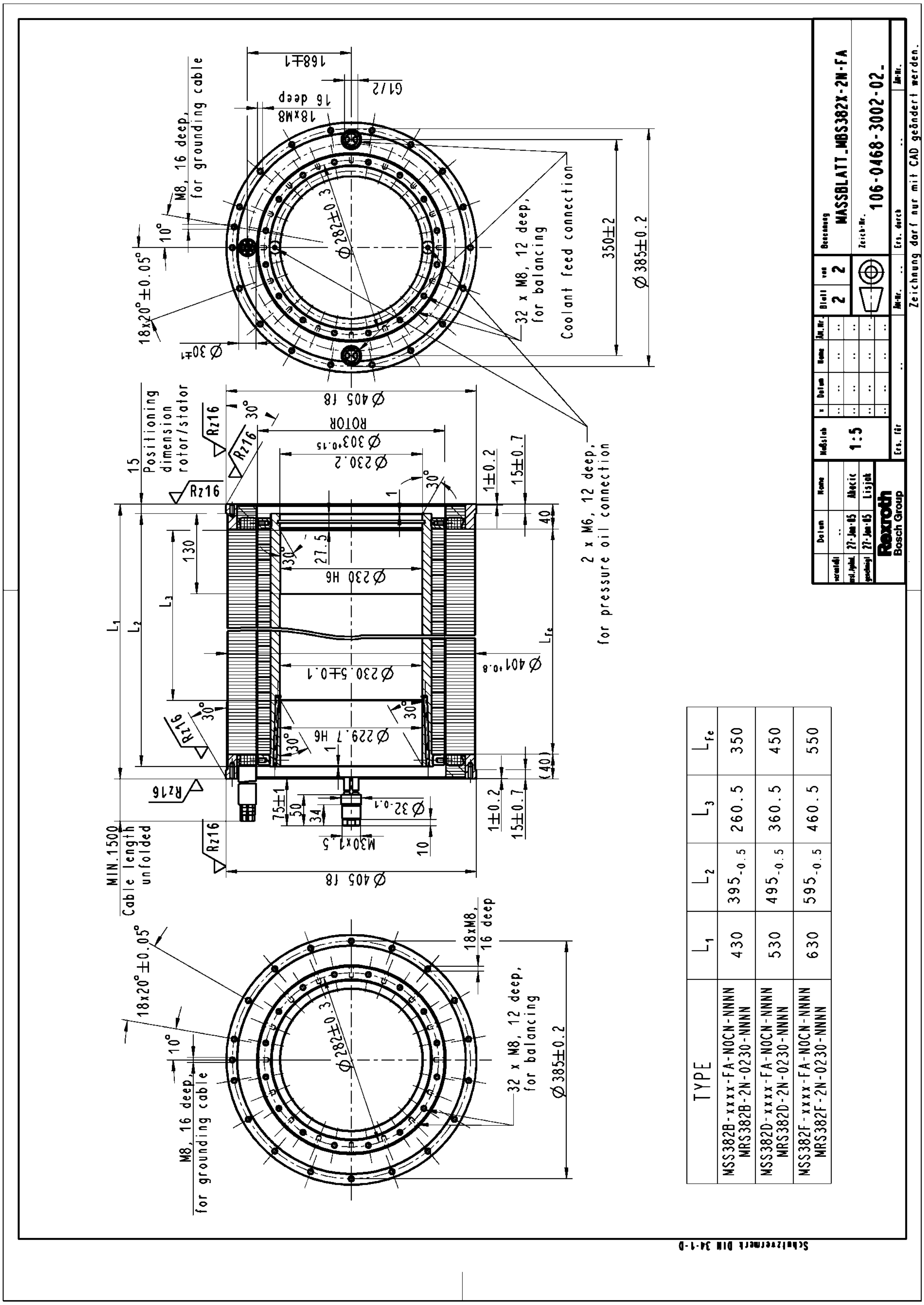
MBS382 with Axial Cooling Connection and Rotor Design “1N”



106-0468-3001-02.TIF

Fig. 5-35: MBS382 with Axial Cooling Connection and Rotor Design “1N”

MBS382 with Axial Cooling Connection and Rotor Design “2N”

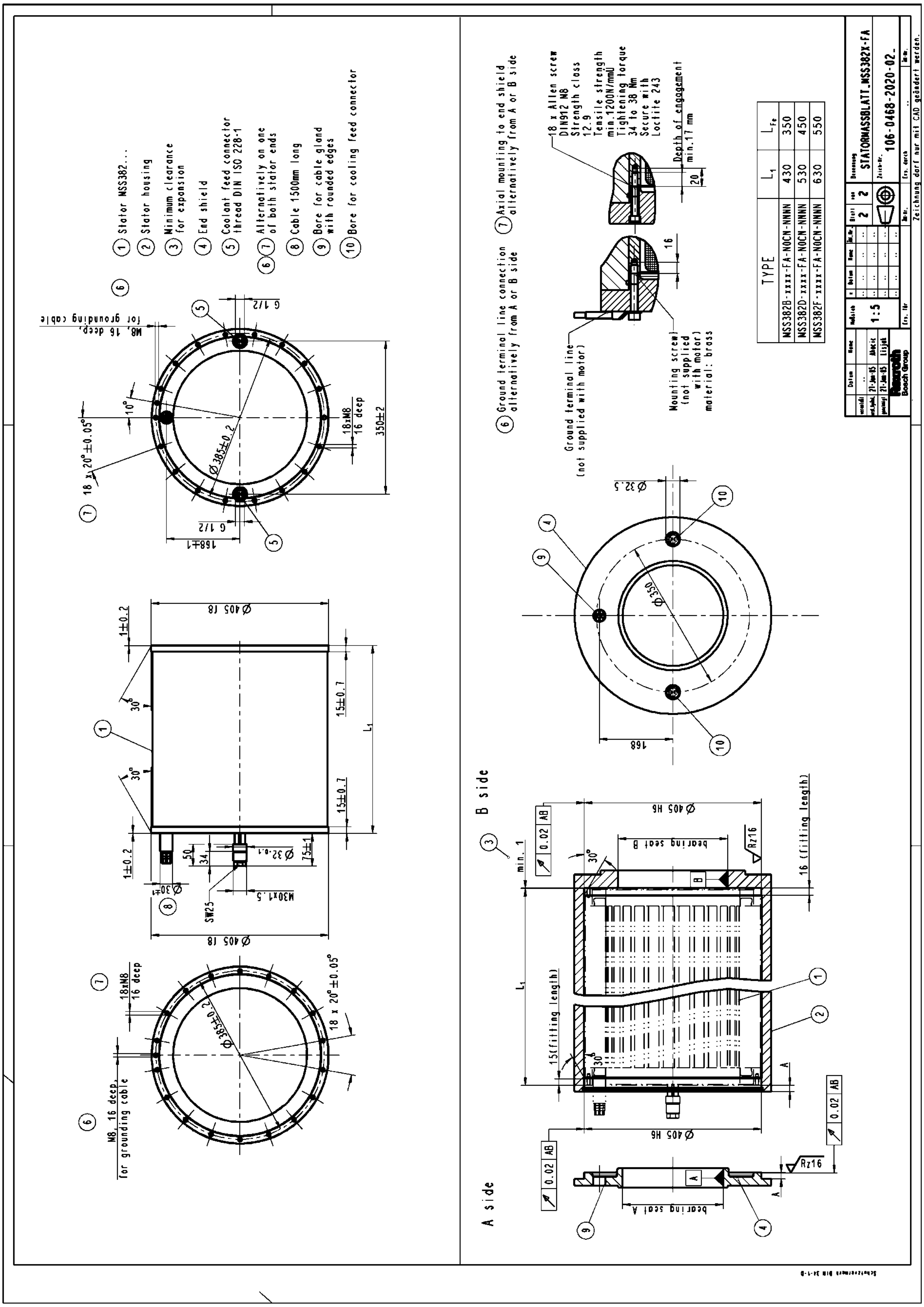


TYPE	L_1	L_2	L_3	L_{fe}
NSS382B-xxxx-FA-N0CN-NNNN NRS382B-2N-0230-NNNN	430	$395_{-0.5}$	260.5	350
NSS382D-xxxx-FA-N0CN-NNNN NRS382D-2N-0230-NNNN	530	$495_{-0.5}$	360.5	450
NSS382F-xxxx-FA-N0CN-NNNN NRS382F-2N-0230-NNNN	630	$595_{-0.5}$	460.5	550

106-0468-3002-02.TIF

Fig. 5-36: MBS382 with Axial Cooling Connection and Rotor Design “2N”

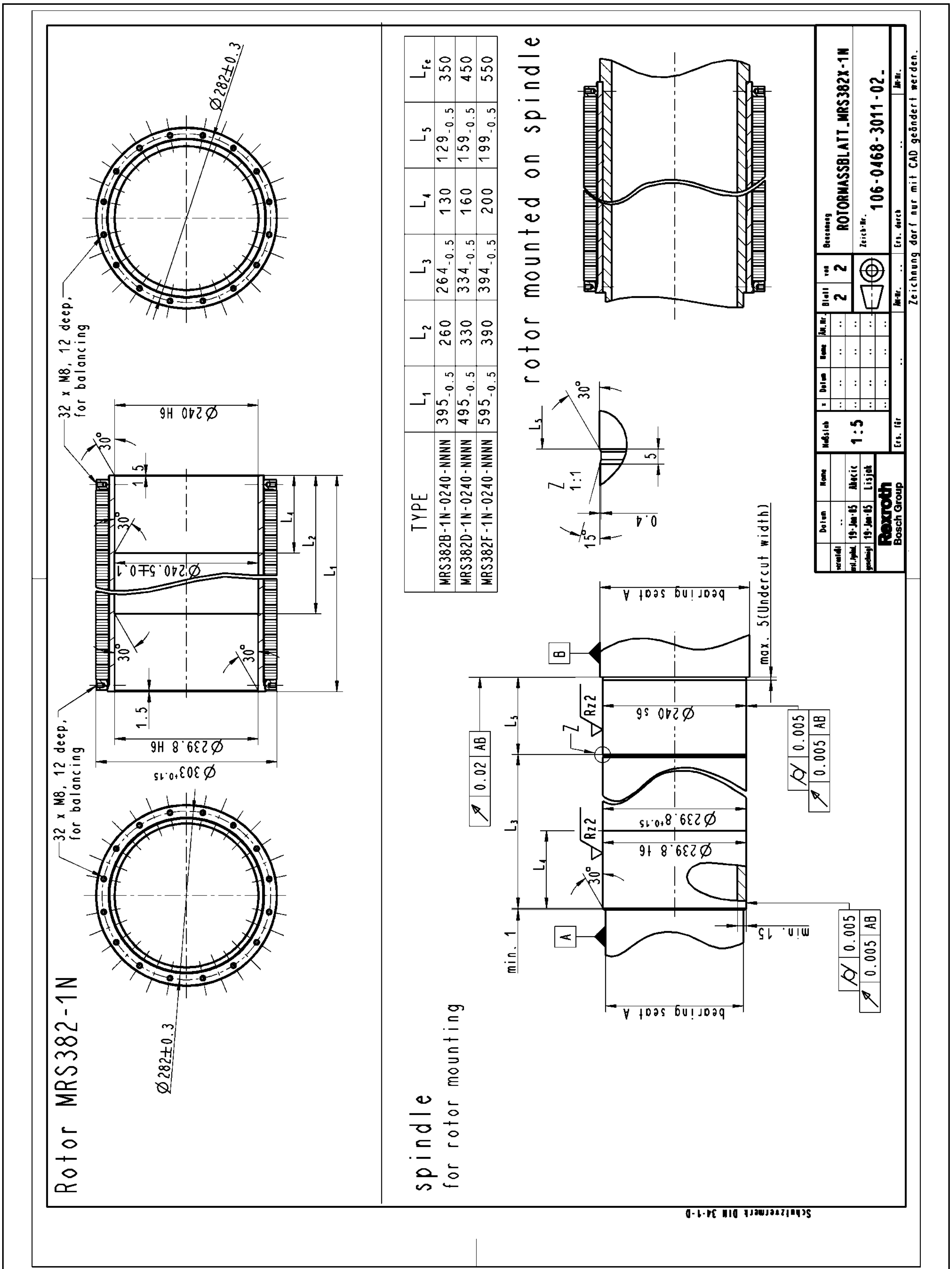
MSS382, axial cooling connection



106-0468-2020-02.TIF

Fig. 5-37: MSS382, axial cooling connection

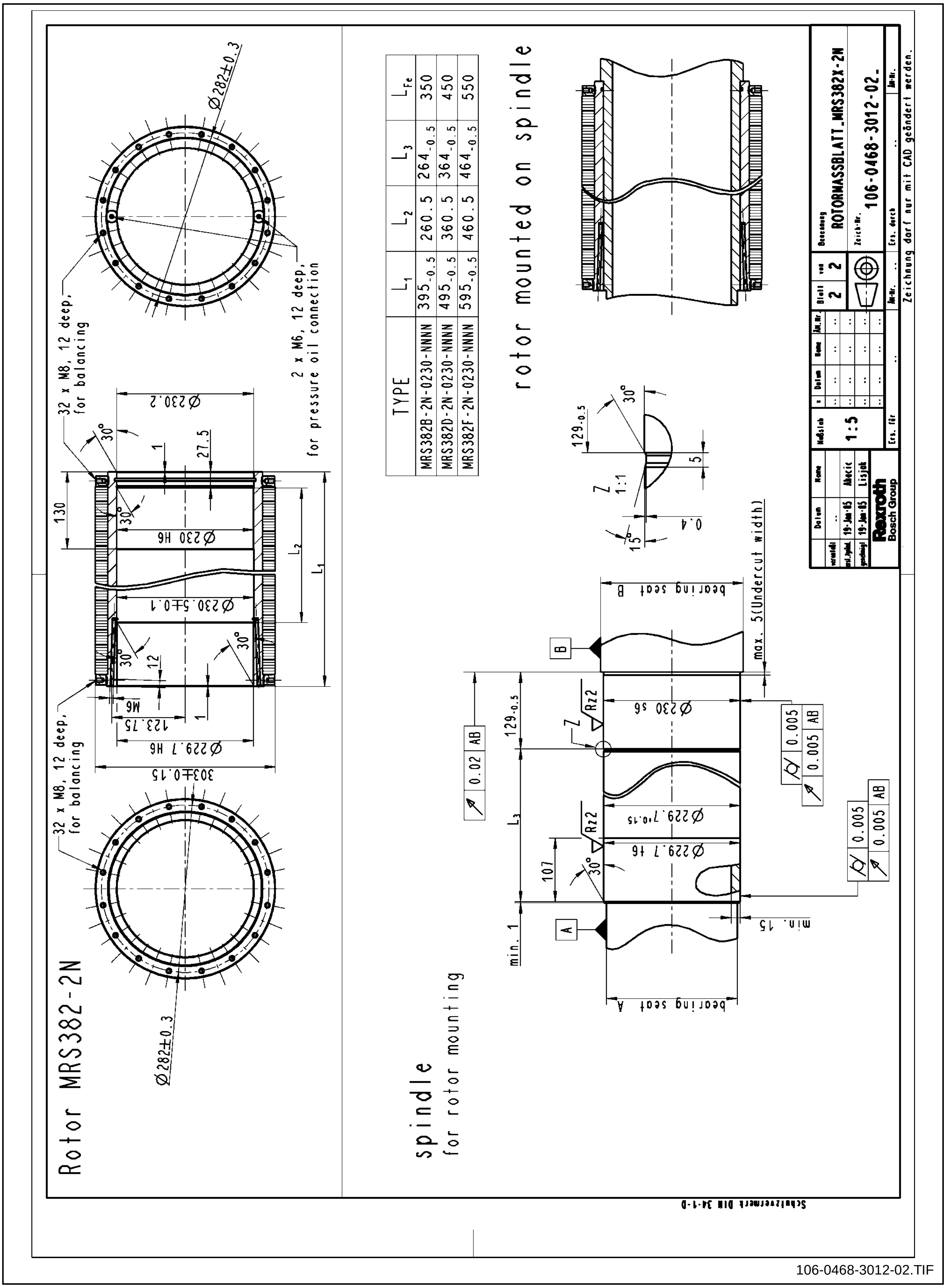
MRS382 in design 1N



106-0468-3011-02.TIF

Fig. 5-38:	MRS382 in design 1N

MRS382 in design 2N



TYPE	L_1	L_2	L_3	L_{Fe}
MRS382B-2N-0230-NNNN	$395_{-0.5}$	260.5	$264_{-0.5}$	350
MRS382D-2N-0230-NNNN	$495_{-0.5}$	360.5	$364_{-0.5}$	450
MRS382F-2N-0230-NNNN	$595_{-0.5}$	460.5	$464_{-0.5}$	550

Fig. 5-39: MRS382 in design 2N

6 Type Codes of IndraDyn H Motors

6.1 Introduction

The type code describes the available motor variants; it is the basis for selecting and ordering products from BOSCH REXROTH. This applies to both new products as well as spare parts and repairs.

“IndraDyn H” is the overall product designation for the new high-speed synchronous kit motor series of REXROTH. The IndraDyn H motors include additional technical developments made to the MBS motor series.

IndraDyn H motors are kit motors. For this reason, both rotor and stator have their own unique type codes.

The designation of rotor (MRS) and stator (MSS) are the same as for MBS motors. To differentiate the motors, the “IndraDyn H” generation contains a “2” in the 6th position of the type codes (e.g. MSSxx2 / MRSxx2).

The following figures give examples of motor type codes for rotors and stators. With a proper type code, an exact specification of the single parts (e.g. for orders) is possible.

The following description gives an overview of the individual positions (”abbrev. column”) of the type codes and their meanings.

Note: When selecting a product, always consider the detailed specifications in chapter 4 “Technical Data” and in chapter 9 “Notes regarding Application”.

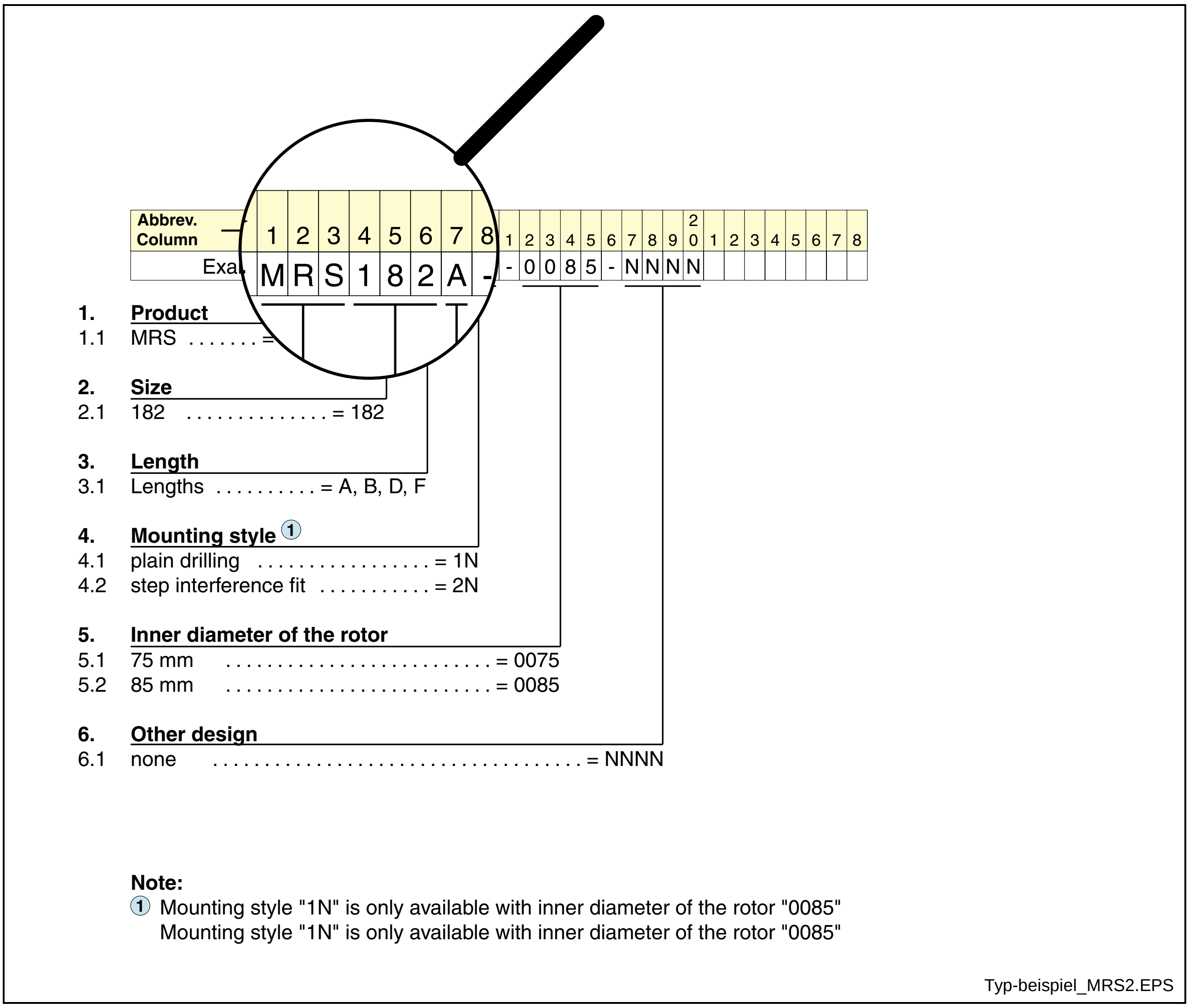


Fig. 6-1: IndraDyn H type code example MRS

Type Code for Rotor "MRS"

1. Product Group

Abbrev. column 1 2 3

MRS is the rotor designation of a high-speed synchronous kit motor of the IndraDyn H series.

2. Motor Frame Size

Abbrev. column 4 5 6

The motor frame size is derived from stator dimensions and represents different power ranges.

3. Motor Frame Length

Abbrev. column 7

Within a series, the graduation of increasing motor frame length is indicated by ID letters in alphabetic order. The higher the motor frame length, the higher the torque.

Frame lengths are, for example, **A**, **B**, **C**, **D** and **E**.

4. Shape/mechanical construction

Abbreviation columns 9 10

Specifies the type of how the rotor is bored.

1N = smooth rotor drilling,

2N = step interference fit.

For further information to design please refer to the chapter 9.6 "Design and assembly principle of rotor/spindle shaft".

5. Rotor - internal diameter

Abbrev. column 12 13 14 15

Represents the internal diameter of the rotor in millimeter (mm).

6. Other designs

Abbrev. column 17 18 19 20

Reserved for optional types. You can find a short description in the appropriate type code, mechanical details in the respective dimension sheet.

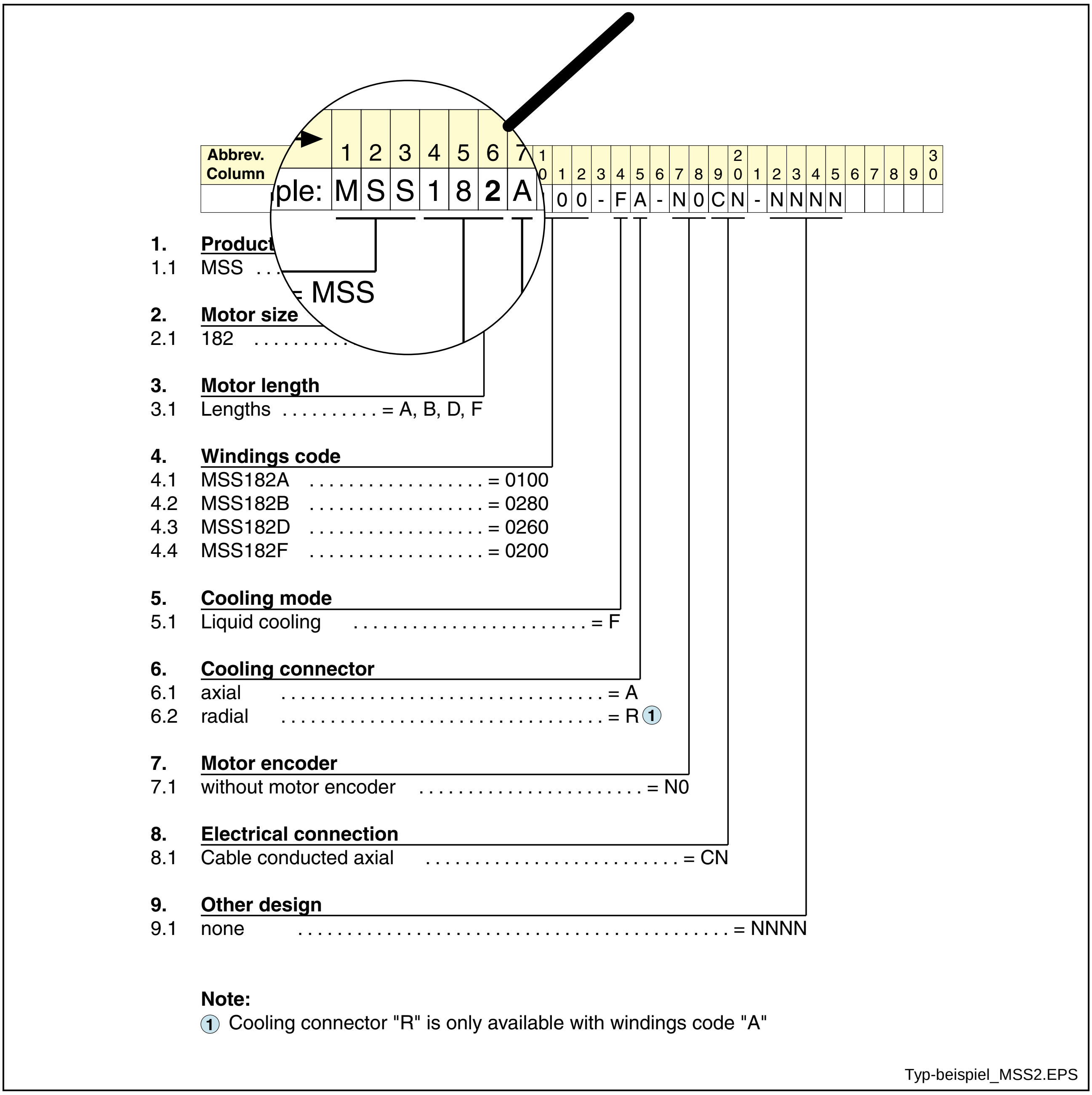


Fig. 6-2: IndraDyn H type code example MSS

Type Code for Stator "MSS"

1. Product

Abbrev. column 1 2 3

MSS is the stator designation of a high-speed synchronous kit motor of the IndraDyn H series.

2. Motor Frame Size

Abbrev. column 4 5 6

The motor frame size is derived from stator dimensions and represent different power ranges.

3. Motor Frame Length

Abbrev. column 7

Within a series, the graduation of increasing motor frame length is indicated by ID letters in alphabetic order. The higher the motor frame length, the higher the torque.

Frame lengths are, for example, **A**, **B**, **C**, **D** and **E**.

4. Winding Code

Abbrev. column 9 10 11 12

The winding codes “0120”, “0170”, etc. differentiate winding variants and refer to the rated speed.

Example: The rated speed for the winding “0120” is n_N = 1200 rpm.·The DC bus voltage of 540 V_{DC}. is a fixed reference value.

A drive combination is selected based on the corresponding selection data and operating characteristics.

5. Type of cooling

Abbrev. column 14

Generally, IndraDyn H motors are fitted with a stator-cooling jacket. They are intended to be **liquid cooled.**

6. Cooling connection

Abbrev. column 15

Specifies the position of the cooling connection on the stator.

7. Motor Encoder

Abbrev. columns 17 18

IndraDyn H-motors not available with a motor encoders. For information to the motor encoder, see chapter 9 “Application notes”.

8. Electrical Connection

Abbrev. columns 19 20

The electrical connection is made via a 1.5-meter cables with flying leads.

For more information see chapter 8 “Connection system”.

9. Other designs

Abbrev. column 22 23 24 25

Reserved for optional types. You can find a short description in the appropriate type code, mechanical details in the respective dimension sheet.

6.2 Type Code MRS102

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40

Example: M R S 1 0 2 B - 1 N - 0 0 4 6 - N N N N

1. **Product**
1.1 MRS . . . . = MRS

2. **Size**
2.1 102 . . . . = 102

3. **Length**
3.1 Lengths . . . . = B, D, F

4. **Mounting style** (1)
4.1 plain drilling . . . . = 1N
4.2 step interference fit . . . . = 2N

5. **Inner diameter of the rotor**
5.1 35 mm . . . . = 0035
5.2 46 mm . . . . = 0046

6. **Other design**
6.1 none . . . . = NNNN

Note:
(1) Mounting style "1N" is only available with inner diameter of the rotor "0046"
Mounting style "2N" is only available with inner diameter of the rotor "0035"

RNC-41241-021_NOR_E_D0_2004-04-052.EPS

Fig. 6-3: Type Code MRS102

6.3 Type Code MSS102

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40

Example: M S S 1 0 2 B - 0 8 0 0 - F A - N 0 C N - N N N N

1. **Product**
1.1 MSS . . . . = MSS

2. **Size**
2.1 102 . . . . = 102

3. **Length**
3.1 Lengths . . . . = B, D, F

4. **Windings**
4.1 MSS102B . . . . = 0800
4.2 MSS102D . . . . = 0800
4.3 MSS102F . . . . = 0800

5. **Cooling mode**
5.1 Liquid cooling . . . . = F

6. **Cooling connector**
6.1 axial . . . . = A

7. **Encoder**
7.1 without motor encoder . . . . = N0

8. **Electrical connection**
8.1 Cable conducted axial . . . . = CN

9. **Other design**
9.1 none . . . . = NNNN

RNC-41241-022_NOR_E_D0_2003-12-012.EPS

Fig. 6-4: Type Code MSS102

6.4 Type Code MRS142

Abbrev. Column

Example: MRS142B-1N-0058-NNNN

1. Product
1.1 MRS .... = MRS

2. Size
2.1 142 .... = 142

3. Length
3.1 Lengths .... = B, D, F

4. Mounting style (1)
4.1 plain drilling .... = 1N
4.2 step interference fit .... = 2N

5. Inner diameter of the rotor
5.1 50 mm .... = 0050
5.2 58 mm .... = 0058

6. Other design
6.1 none .... = NNNN

Note:
(1) Mounting style "1N" is only available with inner diameter of the rotor "0058"
Mounting style "2N" is only available with inner diameter of the rotor "0050"

RNC-41241-421_NOR_E_D0_2004-04-052.EPS

Fig. 6-5: Type Code MRS142

6.5 Type Code MSS142

Abbrev. Column

Example: MSS142B-0700-FA-N0CN-NNNN

1. Product
1.1 MSS .... = MSS

2. Size
2.1 142 .... = 142

3. Length
3.1 Lengths .... = B, D, F

4. Windings
4.1 MSS142B .... = 0700
4.2 MSS142D .... = 0700
4.3 MSS142F .... = 0700

5. Cooling mode
5.1 Liquid cooling .... = F

6. Cooling connector
6.1 axial .... = A

7. Encoder
7.1 without motor encoder .... = N0

8. Electrical connection
8.1 Cable conducted axial .... = CN

9. Other design
9.1 none .... = NNNN

RNC-41241-422_NOR_E_D0_2003-08-12.EPS

Fig. 6-6: Type Code MSS142

6.6 Type Code MRS162

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40

Example: M R S 1 6 2 B - 1 N - 0 0 6 8 - N N N N

1. Product
1.1 MRS . . . . = MRS

2. Motor size
2.1 162 . . . . = 162

3. Motor length
3.1 Lengths . . . . = B, D, F, J

4. Mounting style ①
4.1 plain drilling . . . . = 1N
4.2 step interference fit . . . . = 2N

5. Inner diameter of the rotor
5.1 60 mm . . . . = 0060
5.2 68 mm . . . . = 0068

6. Other design
6.1 none . . . . = NNNN

Note:
① Mounting style "1N" is only available with rotor inner diameter of the rotor "0068"
Mounting style "2N" is only available with rotor inner diameter of the rotor "0060"

RNC-41241-621_NOR_E_D0_2004-04-052.EPS

Fig. 6-7: Type Code MRS162

6.7 Type Code MSS162

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40

Example: M S S 1 6 2 B - 0 4 0 0 - F R - N 0 C N - N N N N

1. Product
1.1 MSS . . . . = MSS

2. Motor size
2.1 202 . . . . = 202

3. Motor length
3.1 Lengths . . . . = B, D, F, J

4. Windings code
4.1 MSS162B . . . . = 0400
4.2 MSS162D . . . . = 0400
4.3 MSS162F . . . . = 0310
4.4 MSS162J . . . . = 0200

5. Cooling mode
5.1 Liquid cooling . . . . = F

6. Cooling connector
6.1 axial . . . . = A

7. Motor encoder
7.1 without motor encoder . . . . = N0

8. Electrical connection
8.1 Cable conducted axial . . . . = CN

9. Other design
9.1 none . . . . = NNNN

RNC-41241-622_NOR_N_D0_2003-06-252.EPS

Fig. 6-8: Type Code MSS162

6.8 Type Code MRS182

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40

Example: M R S 1 8 2 A - 1 N - 0 0 8 5 - N N N N

1. **Product**
1.1 MRS .... = MRS

2. **Size**
2.1 182 .... = 182

3. **Length** ①
3.1 Lengths .... = A, B, D, F

4. **Mounting style** ②
4.1 plain drilling .... = 1N
4.2 step interference fit .... = 2N

5. **Internal diameter of the rotor**
5.1 75 mm .... = 0075
5.2 85 mm .... = 0085

6. **Other design**
6.1 none .... = NNNN

Note:
① Length "A" is only available with Mounting style "1N"
② Mounting style "1N" is only available with internal diameter of the rotor "0085"
Mounting style "1N" is only available with internal diameter of the rotor "0085"

RNC-41241-821_NOR_E_D0_2003-08-042.EPS

Fig. 6-9: Type Code MRS182

6.9 Type Code MSS182

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40

Example: M S S 1 8 2 A - 0 1 0 0 - F A - N 0 C N - N N N N

1. **Product**
1.1 MSS .... = MSS

2. **Motor size**
2.1 182 .... = 182

3. **Motor length**
3.1 Lengths .... = A, B, D, F

4. **Winding code**
4.1 MSS182A .... = 0100, 0250
4.2 MSS182B .... = 0280
4.3 MSS182D .... = 0260
4.4 MSS182F .... = 0200

5. **Cooling mode**
5.1 Liquid cooling .... = F

6. **Cooling connector**
6.1 axial .... = A
6.2 radial .... = R ①

7. **Motor encoder**
7.1 without motor encoder .... = N0

8. **Electrical connection**
8.1 Cable conducted axial .... = CN

9. **Other design**
9.1 none .... = NNNN

Note:
① Cooling connector "R" is only available with winding code "A"

RNC-41241-822_NOR_E_D0_2003-08-042.EPS

Fig. 6-10: Type Code MSS182

6.10 Type Code MRS202

Abbrev. Column →

Example: MRS202B-1N-0096-NNNN

1. Product
1.1 MRS . . . . = MRS

2. Size
2.1 202 . . . . = 202

3. Length
3.1 Lengths . . . . = A, B, D, F

4. Mounting style ①
4.1 plain drilling . . . . = 1N
4.2 step interference fit . . . . = 2N

5. Inner diameter of the rotor
5.1 85 mm . . . . = 0085
5.2 96 mm . . . . = 0096

6. Other design
6.1 none . . . . = NNNN

Note:
① Mounting style "1N" is only available with inner diameter of the rotor "0096"
Mounting style "2N" is only available with inner diameter of the rotor "0086"

RNC-41242-021_NOR_E_D0_2004-04-062.EPS

Fig. 6-11: Type Code MRS202

6.11 Type Code MSS202

Abbrev. Column →

Example: MSS202B-0150-FA-N0CN-NNNN

1. Product
1.1 MSS . . . . = MSS

2. Size
2.1 202 . . . . = 202

3. Length
3.1 Lengths . . . . = A, B, D, F

4. Winding code
4.1 MSS202A . . . . = 0200
4.2 MSS202B . . . . = 0150, 0210
4.3 MSS202D . . . . = 0170
4.4 MSS202F . . . . = 0120

5. Cooling mode
5.1 Liquid cooling . . . . = F

6. Cooling connector
6.1 axial . . . . = A

7. Motor encoder
7.1 without motor encoder . . . . = N0

8. Electrical connection
8.1 Cable conducted axial . . . . = CN

9. Other design
9.1 none . . . . = NNNN

RNC-41242-022_NOR_E_D0_2004-02-032.EPS

Fig. 6-12: Type Code MSS202

6.12 Type Code MRS242

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 ... 40

Example: M R S 2 4 2 B - 1 N - 0 1 1 0 - N N N N

1. Product
1.1 MRS . . . . = MRS

2. Size
2.1 242 . . . . = 242

3. Length
3.1 Lengths . . . . = B, D, F

4. Mounting style ①
4.1 plain drilling . . . . = 1N
4.2 step interference fit . . . . = 2N

5. Inner diameter of the rotor
5.1 100 mm . . . . = 0100
5.2 110 mm . . . . = 0110

6. Other design
6.1 none . . . . = NNNN

Note:
① Mounting style "1N" is only available with inner diameter of the rotor "0110"
Mounting style "2N" is only available with inner diameter of the rotor "0100"

RNC-41242-421_NOR_E_D0_2004-04-072.EPS

Fig. 6-13: Type Code MRS242

6.13 Type Code MSS242

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 ... 40

Example: M S S 2 4 2 B - 0 1 0 0 - F A - N 0 C N - N N N N

1. Product
1.1 MSS . . . . = MSS

2. Size
2.1 242 . . . . = 242

3. Length
3.1 Lengths . . . . = B, D, F

4. Windings
4.1 MSS242B . . . . = 0100
4.2 MSS242D . . . . = 0070
4.3 MSS242F . . . . = 0060

5. Cooling mode
5.1 Liquid cooling . . . . = F

6. Cooling connector
6.1 axial . . . . = A

7. Encoder
7.1 without motor encoder . . . . = N0

8. Electrical connection
8.1 Cable conducted axial . . . . = CN

9. Other design
9.1 none . . . . = NNNN

RNC-41242-422_NOR_E_D0_2003-08-12.EPS

Fig. 6-14: Type Code MSS242

6.14 Type Code MRS272

Abbrev. Column	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	S	2	7	2	B	-	1	N	-	0	1	4	0	-	N	N	N	N																				

1. Product
1.1 MRS . . . . = MRS

2. Size
2.1 272 . . . . = 272

3. Length
3.1 Lengths . . . . = B, D, F

4. Mounting style ①
4.1 plain drilling . . . . = 1N
4.2 step interference fit . . . . = 2N

5. Internal diameter of the rotor
5.1 94 mm . . . . = 0094
5.2 125 mm . . . . = 0125
5.3 135 mm . . . . = 0135

6. Other design
6.1 none . . . . = NNNN

Note:
① Mounting style "1N" is only available with inner diameter of the rotor "0135"
Mounting style "2N" is only available with inner diameter of the rotor "0094" or "0125"

RNC-41242-721_NOR_E_D0_2003-08-182.EPS

Fig. 6-15: Type Code MRS272

6.15 Type Code MSS272

Abbrev. Column	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	S	2	7	2	B	-	0	0	6	5	-	F	A	-	N	0	C	N	-	N	N	N	N															

1. Product
1.1 MSS . . . . = MSS

2. Size
2.1 272 . . . . = 272

3. Length
3.1 Lengths . . . . = B, D, F

4. Windings
4.1 MSS272B . . . . = 0065
4.2 MSS272D . . . . = 0050
4.3 MSS272F . . . . = 0040

5. Cooling mode
5.1 Liquid cooling . . . . = F

6. Cooling connector
6.1 axial . . . . = A

7. Encoder
7.1 without motor encoder . . . . = N0

8. Electrical connection
8.1 Cable conducted axial . . . . = CN

9. Other design
9.1 none . . . . = NNNN

RNC-41242-722_NOR_N_D0_2003-12-012.EPS

Fig. 6-16: Type Code MSS272

6.16 Type Code MRS312

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40

Example: MRS312B-1N-0170-NNNN

1. Product
1.1 MRS .... = MRS

2. Size
2.1 312 .... = 312

3. Length ①
3.1 Lengths .... = B, D, F, H

4. Mounting style ②
4.1 plain drilling .... = 1N
4.2 step interference fit .... = 2N

5. Internal diameter of the rotor
5.1 112 mm .... = 0112
5.2 130 mm .... = 0130
5.3 160 mm .... = 0160
5.4 170 mm .... = 0170

6. Other design
6.1 none .... = NNNN

Note:
① Length "H" ist only available with mountig style "2N"
② Mounting style "1N" is only available with internal diameter of the rotor "0170"
Mounting style "2N" is only available with internal diameter of the rotor "0112", "0130" or "0160"

RNC-41243-121_NOR_E_D0_2003-08-182.EPS

Fig. 6-17: Type Code MRS312

6.17 Type Code MSS312

Abbrev. Column → 1 2 3 4 5 6 7 8 9 10 1 2 3 4 5 6 7 8 9 20 1 2 3 4 5 6 7 8 9 30 1 2 3 4 5 6 7 8 9 40

Example: MSS312B-0035-FA-N0CN-NNNN

1. Product
1.1 MSS .... = MSS

2. Size
2.1 312 .... = 312

3. Length
3.1 Lengths .... = B, D, F, H

4. Windings
4.1 MSS312B .... = 0035
4.2 MSS312D .... = 0028
4.3 MSS312F .... = 0028
4.4 MSS312H .... = 0025, 0085

5. Cooling mode
5.1 Liquid cooling .... = F

6. Cooling connection
6.1 axial .... = A
6.2 radial .... = R

7. Encoder
7.1 without motor encoder .... = N0

8. Electrical connection
8.1 Cable conducted axial .... = CN

9. Other design
9.1 none .... = NNNN

RNC-41243-122_NOR_N_D0_2004-11-192.EPS

Fig. 6-18: Type Code MSS312

6.18 Type Code MRS382

Abbrev. Column: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 ... 40

Example: M R S 3 8 2 F - 1 N - 0 2 4 0 - N N N N

1. Product
1.1 MRS . . . . = MRS

2. Motor size
2.1 382 . . . . = 382

3. Motor length
3.1 Length . . . . = F

4. Mounting style ①
4.1 plain drilling . . . . = 1N
4.2 step interference fit . . . . = 2N

5. Internal diameter of rotor
5.1 230 mm . . . . = 0230
5.2 240 mm . . . . = 0240

6. Other design
6.1 none . . . . = NNNN

Note:
① Mounting style "1N" is only available with internal diameter of rotor "0240"
Mounting style "2N" is only available with internal diameter of rotor "0230"

RNC-41243-821_NOR_E_D0_2004-02-132.EPS

Fig. 6-19: Type Code MRS382

6.19 Type Code MSS382

Abbrev. Column: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 ... 40

Example: M S S 3 8 2 F - 0 0 1 8 - F A - N 0 C N - N N N N

1. Product
1.1 MSS . . . . = MSS

2. Motor size
2.1 382 . . . . = 382

3. Motor length
3.1 Length . . . . = F

4. Windings code
4.1 MSS382F . . . . = 0018

5. Cooling mode
5.1 Liquid cooling . . . . = F

6. Cooling connector
6.1 axial . . . . = A

7. Motor encoder
7.1 without motor encoder . . . . = N0

8. Electrical connection
8.1 Cable conducted axial . . . . = CN

9. Other design
9.1 none . . . . = NNNN

RNC-41243-822_NOR_N_D0_2003-07-142.EPS

Fig. 6-20: Type Code MSS382

7 Accessories

7.1 O-Rings for the Rotors

If the o-ring for the step interference fit on the rotor was damaged during transport or assembly, it can be re-ordered through Bosch Rexroth according to the exact rotor type and the specified rotor material number, a.k.a. MNR.

Rotor MRS...	O-ring	MNR
102x-2N-0035-xxxx	35x4 75FKM	R911______*
142x-2N-0050-xxxx	50x4 75FKM	R911______*
162x-2N-0060-xxxx	60x4 75FKM	R911______*
182x-2N-0075-xxxx	75x4 75FKM	R911______*
202x-2N-0066-xxxx	66x4 75FKM	R911______*
202x-2N-0085-xxxx	85x4 75FKM	R911______*
242x-2N-0100-xxxx	100x4 75FKM	R911______*
272x-2N-0094-xxxx	94x4 75FKM	R911______*
272x-2N-0125-xxxx	125x4 75FKM	R911______*
312x-2N-0112-xxxx	112x4 75FKM	R911______*
312x-2N-0130-xxxx	130x4 75FKM	R911______*
312x-2N-0160-xxxx	160x4 75FKM	R911______*
382x-2N-0230-xxxx	230x4 75FKM	R911______*
* in preparation		

Fig. 7-1: O-Rings for rotor design ..-2N-..

8 Connection Techniques

8.1 Notes

Rexroth offers a wide range of ready-made cables for IndraDyn H motors; these cables are optimally configured for the most diverse demands.

Decisive advantages of Rexroth ready-made cables are:

- Pre-wired without additional finishing
- Designed for continuous flexing
- Resistant against mineral oils, grease and biologic oils, silicon- and halogen-free, low adhesion
- Use of licensed cables acc. to UL and CSA
- Burning characteristics fulfill VDE0472-804 requirements
- Compliance of the EMC-guideline and protection class up to IP67

Note:

- **Note that self-assembled cables or cable systems of other manufactures may not fulfill these criteria.**
- **Rexroth shall not be held responsible for resulting malfunctions or damage.**
- The chosen connectors must be suitable for the DC bus voltages present.
- The design of the power cable also depends on the control device used. Please observe the documentation of the drive device.

You can find additional information ...

- on selecting power and encoder cables for **IndraDyn H** in the Documentation “Rexroth Connection Cables”, MNR R911282688
- for assembling **cables and plugs**, as well as technical data, in the documentation "Rexroth Connection Techniques, Assembling and Tools...", MNR R911286117.
- for **connection and dimensioning** of cooling systems refer to documentation “ Liquid cooling of Rexroth drive components”, MNR R911266417
- for “**electromagnetic compatibility** (EMC) at drive and control systems” of the same denominator documentation, MNR R911259814.

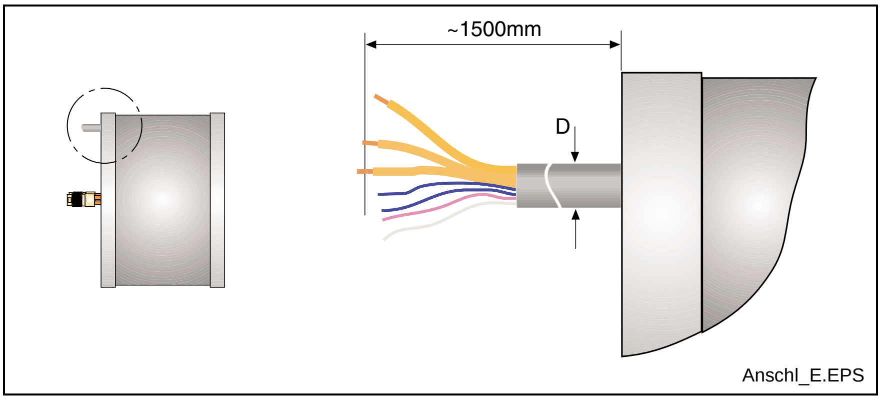
8.2 Power connector

The power connection of the kit-spindle-motor can be made via

- **clamping connection** (terminal box) or with
- **connectors** (flange socket).

The power supply from this junction to the drive device can be made via a power cable. Ready-made connection cables are available from Rexroth.

The stator is provided with an approx. 1.5m long power cable (flying leads in a protective conduit). The power cable consists of three power leads (alt. three pairs of power leads) and two wire pairs for the thermistors within the end turns of winding.



D: Diameter cable harness

Fig. 8-1: IndraDyn H cable harness

Connection wires within the cable harness

The cross-sections of the power conductors in the cable harness depend on the rated current of the motor. In the following table you can find further details about the cross-section of the conductors.

The cross-section of the wire pairs for the thermistors is 0.25mm² (KTY84) or 0.5mm² (SNM.150).

Motor frame size	Cross-section of the power wires [mm²]	Cross-section of the control wires [mm²]	Diameter of the cable harness (D) +/- 1[mm]	Minimum bending radius static [mm]
MSS102B-0800 MSS102D-0800 MSS102F-0800	2.5 4 10		13 13 22	50 70 130
MSS142B-0700 MSS142D-0700 MSS142F-0700	6 16 16		16 22 22	100 150 150
MSS162B-0400 MSS162D-0400 MSS162F-0400 MSS162J-0400	10 16 16 16	2 x 0.25 2 x 0.5	22	130 150 150 150
MSS182A-0100 MSS182B-0280 MSS182D-0260 MSS182F-0200	1 16 16 16		13 22 22 22	50 150 150 150

MSS202A-0200 MSS202B-0150 MSS202B-0210 MSS202D-0170 MSS202F-0120 MSS202F-0350	10 10 25 16 16 2 x 16		22 22 30 22 22 30	130 130 170 150 150 170
MSS242B-0100 MSS242D-0070 MSS242F-0060	16		22	150
MSS272B-0065 MSS272D-0050 MSS272F-0040	16	2 x 0,25 2 x 0,5	22	150
MSS312B-0035 MSS312D-0028 MSS312F-0028 MSS312H-0025 MSS312H-0085	16 25 16 16 2 x 25		22 22 30 22 30	150 170 150 150 200
MSS382B-0025 MSS382D-0020 MSS382F-0010 MSS382F-0018	2 x 16		30	170
*) preliminary details				

Fig. 8-2: Wire cross-sections

The motor`s power cable has a motor-internal connection. The insulation of this power cable is designed for higher temperatures; than the insulation of the power cables designed to connect the stator and drive device. Therefore, the details in chapter 4, “Technical Data” regarding the minimum wire cross-section of the power conductors can differ from the cross-sectional areas of the conductors in the motor power cable.

Route of the cable harness

The motor power cable, which is fixed on the stator, is designed with flying leads and may not be exposed to dynamic bending stresses.

When feeding the motor power cable through the spindle housing assure that you

- do not bend the cable to a radius less than the minimum bending radius (see Fig. 8-2).
- smooth the edges of the through-hole on the spindle housing with a chamfer or with a grommet.

Ground Connection

There are threaded holes for the ground connection on the faces of the stator. Use a ring terminal to fasten the ground wire one of the threaded holes.

You can find further details on the exact position of the threaded hole and their threads in chapter 5, “Dimension sheets” of the particular motor. The minimum cross-section depends on the particular motor type. The corresponding data are given in Fig. 8-2.

Note: The indicated minimum cross-section for the power wires is also valid for the ground wire and must be observed.

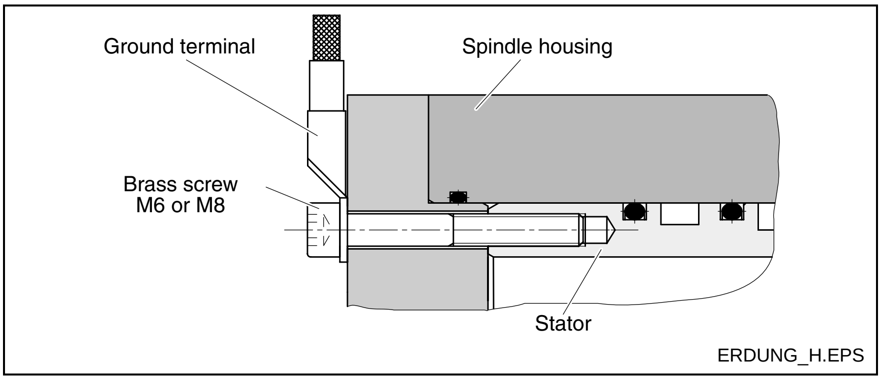


Fig. 8-3: Example of an IndraDyn H ground connection

Proceed as follows:

1. Clean the contact surface for the bolt head. The surface has to be metallic bright that the spindle housing <u>and</u> the stator are grounded.
2. Attach the ring terminal of the ground conductor with a brass screw (M6 or M8, depending on the stator type) to the face of the stator.
3. Grease the connection with Vaseline to protect it from corrosion.

Connection with Terminal Box

The flying leads of the motor power cable can be connected to the power cable from the drive via a three-or six-pole terminal strip in a terminal box. The terminal box should be attached to the spindle housing and should also contain four terminal connections for the PTC thermistor connection.

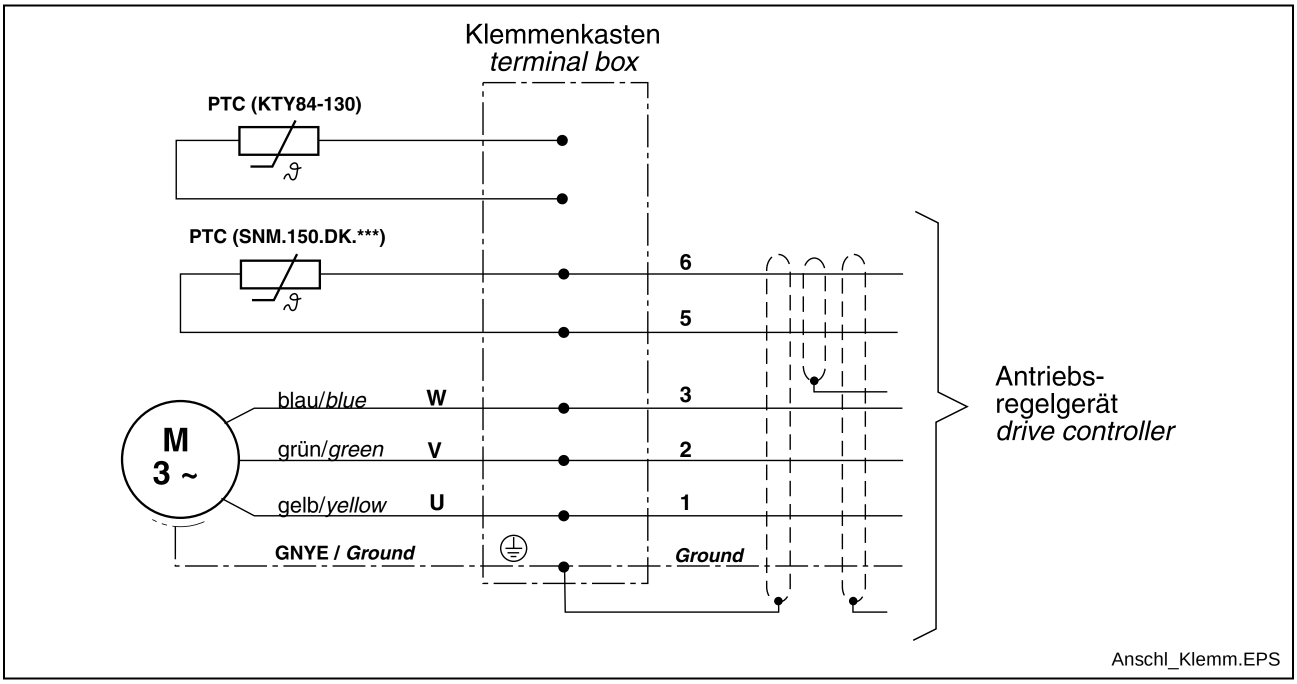


Fig. 8-4: Terminal connection diagram terminal box

The standards listed in the following table must be followed to implement the proper terminations.

	Standard	Reference to termination
Terminal plate	DIN 46 294	Max. rated voltage AC, 660V
Terminal strip	DIN VDE 0110	Max. rated voltage AC, 380V
Terminal studs	DIN 46 200	Determination of the stud diameters and tightening torques
Crimping cable lugs	DIN 46 237	Power wires of the cable harness
Ferrules	DIN 46228, part 3	Flying leads of the PTC thermistor
Degree of Protection	DIN VDE 0530, part 5	Minimum protection class IP54
Terminal marking	EN 60 445	

Fig. 8-5: Standards for terminal-box connections

The components for the connection with terminal box are not available from Rexroth. Possible suppliers are among others:

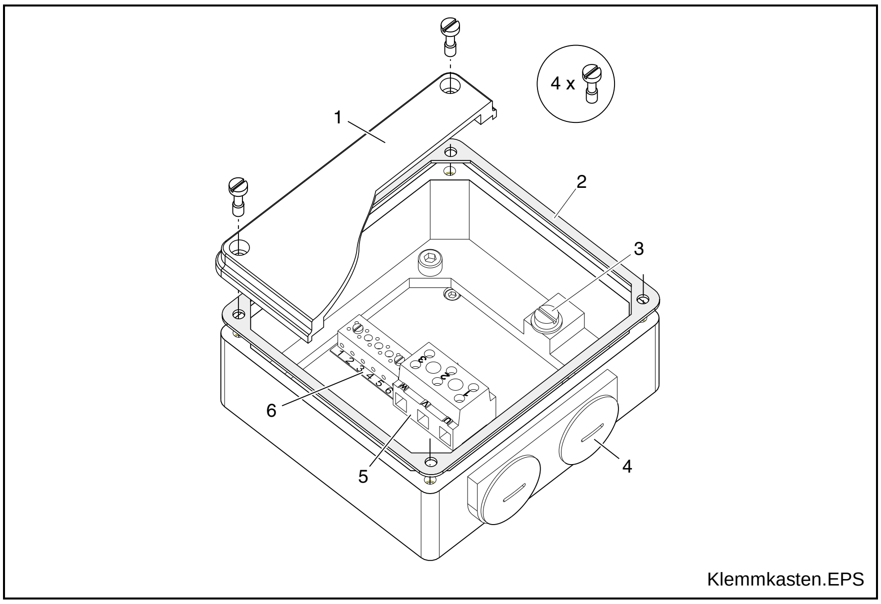
Components	Supplier
Terminal boxes	**KIENLE & SPIESS** Stanz- und Druckgießwerk GmbH Bahnhofstraße 23 74343 Sachsenheim Tel.: +49 (0) 71 47 29 - 0 Fax: +49 (0) 71 47 29 - 1488 Internet www.kienle-spiess.de
Terminal blocks	**MORGAN REKOFA** GmbH & Co. KG Walporzheimer Strasse 100 53474 Bad Neuenahr-Ahrweiler Tel.: +49 (0) 26 41 / 387 - 0 Fax: +49 (0) 26 41 / 387 - 33 95 Mail: info@morgan-rekofa.de
Terminal strips	**WIELAND ELECTRIC** GmbH Benzstrasse 9 96052 Bamberg Internet: www.wieland-electric.com

Fig. 8-6: Suppliers of terminal box components

Pay attention to the following when selecting the components:

- The components must be suited for currents and voltage of the chosen drive system. Especially for high DC bus voltages up to 750 V_{DC}.
- Necessary diameter and connection thread of the PG-thread.
- Impermeability of the housing. Minimum protection class IP65 recommended.

A complete terminal box consists, for example, of the following components:



1:	Cover	2:	Gasket
3:	Ground connection	4:	Cable entry
5:	U-V-W terminal block	6:	Terminal strip

Fig. 8-7: Terminal box

Connection with Coupling

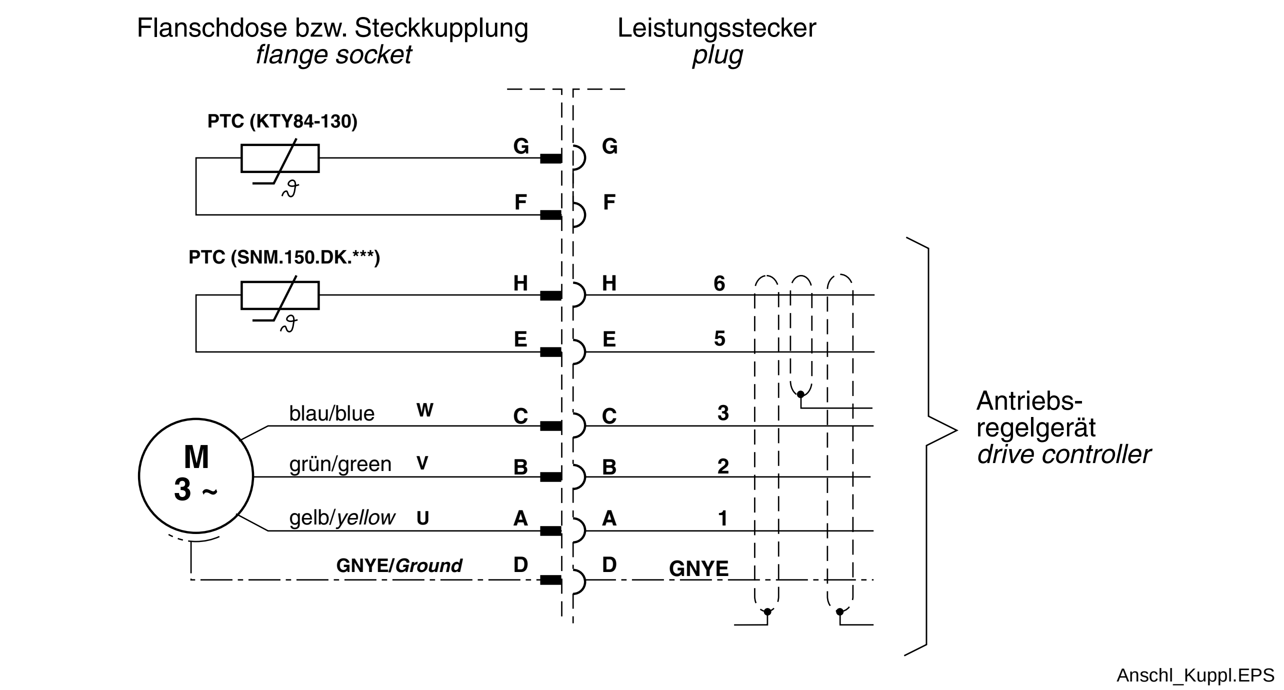


Fig. 8-8: Connection diagram using a coupling

Choose the coupling with the corresponding connector and the necessary connecting diameter according to the motor data sheet.

Order designation: INS0382/**LXX** or INS0482/**LXX**

- ../**L** = Solder version (contact pin with solder contact)
- ../..**XX** = Connection diameter (e.g. 6 mm² = **06**)

The coupling and connector to connect IndraDyn H-motors have a bayonet socket and are not in the scope of delivery.

Note:

- When assembling the connection with crimp contacts, special tools are necessary.
- For more information about making cables and connectors ready to use and technical data see documentation “Connection Cables” MNR R911280894.
- INS0482 is only suitable for a connection diameter up to 10 mm².

Handling

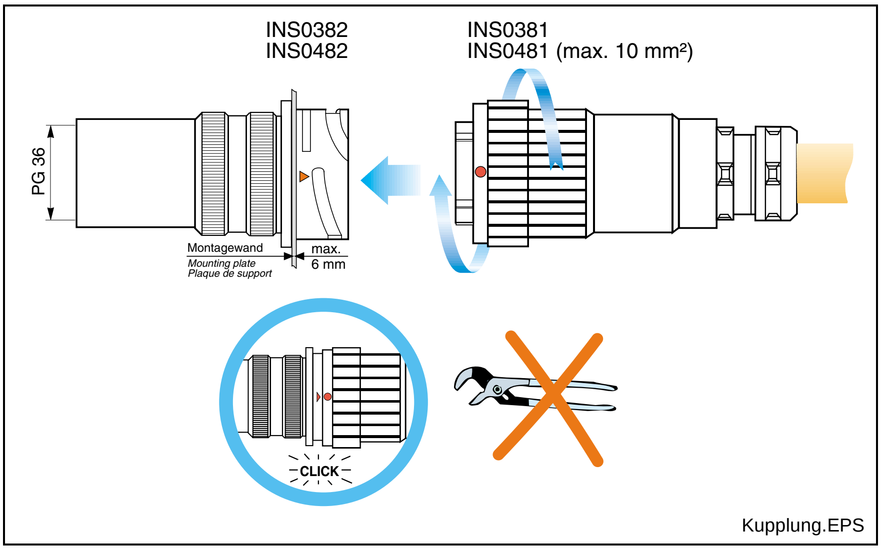


Fig. 8-9: IndraDyn H Power connector

1. Insert the plug into the coupling; pay attention to the coding.
2. Manually tighten the bayonet socket until it audibly locks in.

The red marks on the flange socket and the plug are aligned when the bayonet connection is locked in.

8.3 Connection Designations on the Drive Device

The following overview shows the connection and clamp designations for power connection and the motor temperature monitoring.

REXROTH Drive device	Power connector		Motor Temperature Overview	
	Terminal block	Clamp designations	Terminal block	Clamp designations
IndraDrive HMS.... IndraDrive HCS....	X5	1, 2, 3	X6	MotTemp+ MotTemp-

Fig. 8-10: Clamp designation on the drive device

8.4 Temperature Sensors

IndraDyn H stators are fitted with two types of temperature sensors: SNM.150.DK.* and KTY84-130 sensors. The two are referred to as the “over-temperature-protection” and the “temperature-monitoring” sensors, tespectively. The SNM.150.DK leads must be connected to the drive to protect the motor from overheating, whereas the KTY84-130 sensor is included for the customer to externally monitor the motors operating temperature if desired.

Note:

- To protect the motor from thermal over load, connect the SNM.150.DK temperature sensor to the drive control device.
- Pay attention to the polarity when connecting the KTY84-130 temperature sensor (see. Fig. 8-11).

Wire designation

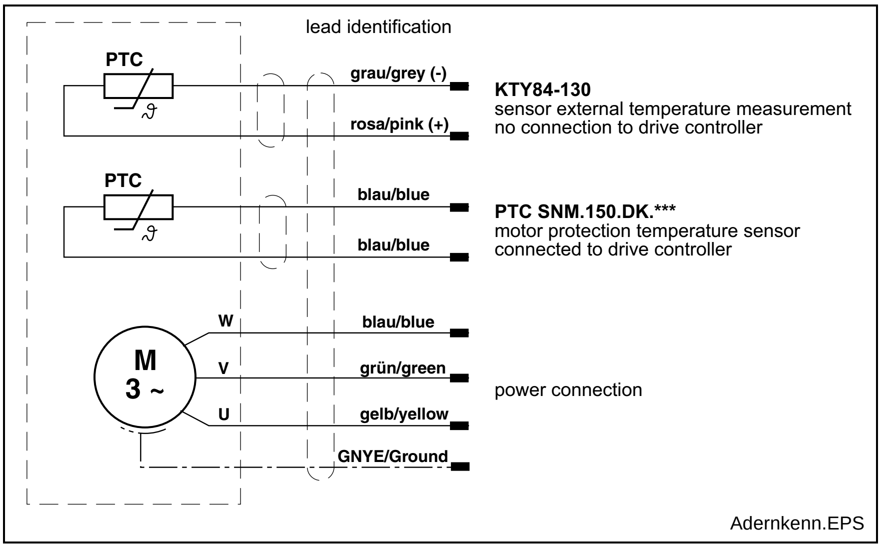


Fig. 8-11: IndraDyn H connection wires

Heed the notes regarding motor temperature control in chapter 9.7, “Motor temperature control”.

8.5 Motor Cooling

The coolant connections on the stator can be designed for axial or radial connections.

You can find more details about dimension, design and position of the cooling agent connections in chapter 5, “Specifications” of the particular motor.

Axial cooling connection

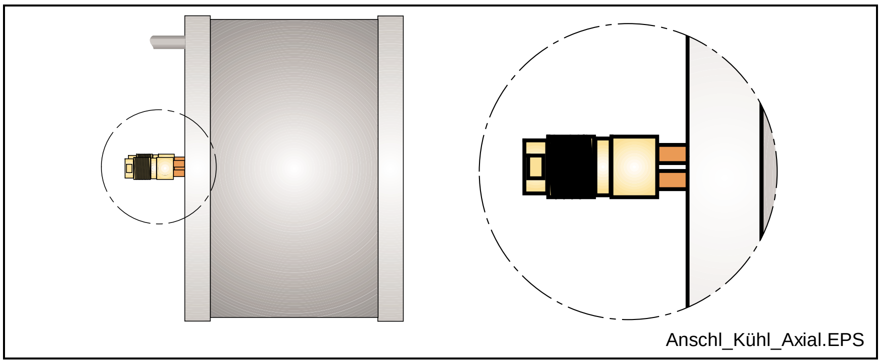


Fig. 8-12: Axial cooling connection

Stator MSS....	Thread “A”	Thread “B”
102 / 142	i.p.	i.p.
162 / 182	G 1/8	M16x1
202 / 242	G 1/4	M22x1.5
272 / 312 / 382	G 1/2	M30x1.5

Fig. 8-13: Overview about axial cooling connection thread

Radial cooling connection

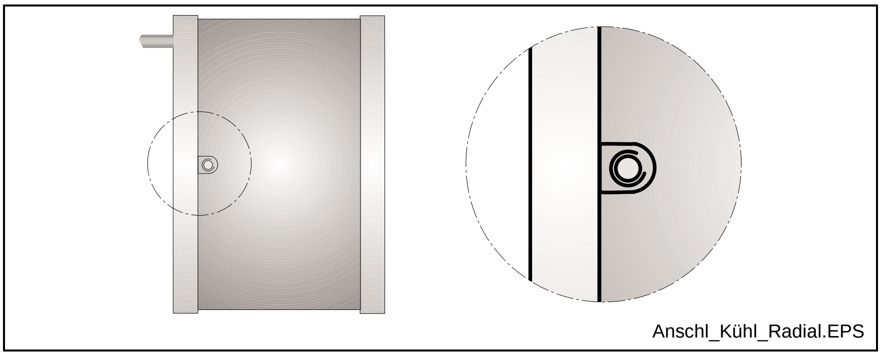


Fig. 8-14: Radial cooling connection

Stator MSS....	Thread “A”
182A	G 1/8
312	G 1/4

Fig. 8-15: Overview about radial cooling connection thread

You can find further information about motor cooling of IndraDyn H motors in chapter 9.6, “Motor Cooling”.

⇒ Notice the motor data in this documentation, as well as the general details for dimensioning of cooling systems in the documentation “Liquid cooling of Rexroth drive components...”, MNR R911265836.

⇒ Install systems in the cooling circuit for monitoring flow, pressure, and temperature.

⇒ Note that intake and outflow are only possible in the position shown in the dimension sheet.

The assignment of intake and outflow has no influence on the performance data of the motor.

Operating Pressure

The **5-bar** maximum coolant inlet pressure applies to all IndraDyn H-motors This value is as measured directly on the coolant connection of the motor.

Please observe that additional threads or branch connections in the cooling circuit can reduce the flow and supply pressure of the coolant.

Select generously-dimensioned connection threads and tube diameters.

8.6 Motor Encoder

Encoder and encoder connection components are not in the scope of delivery of the motor. Choose the components according to the requirements of the machine.

You can find further information about encoder manufacturers in chapter 9.12, “External components”.

Note:

The cables for connecting the motor encoder and the device controller must have a compatible connector on the motor side. When using components of different manufacturers heed the continuous compatibility of the connection system.

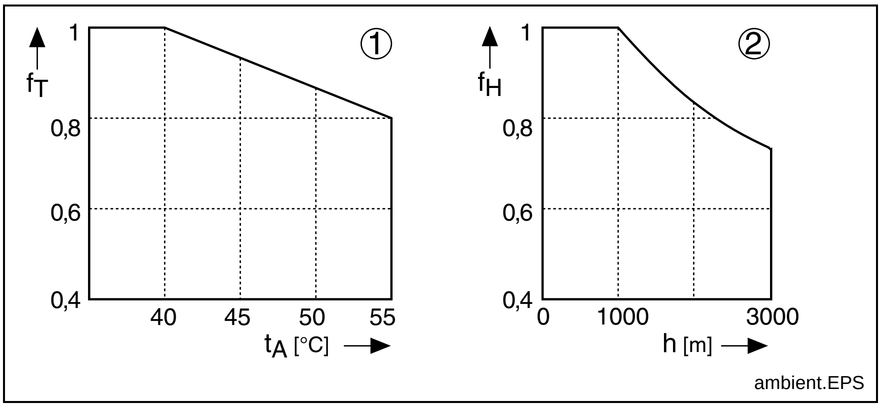
9 Notes Regarding Application

9.1 Setup Elevation and Ambient Temperature

The performance data specified for the motors apply in the following conditions:

- ambient temperature of 0º to +40º C
- setup elevation of 0 to 1,000 m above sea level.

If you want to use the motors in areas with values beyond these ranges, the performance data are reduced according to the following figure.



(1):	Utilization depending on the ambient temperature
(2):	Utilization depending on the setup elevation
f_T:	Temperature utilization factor
t_A:	Ambient temperature in degrees Celsius
f_H:	Height utilization factor
h:	Setup elevation in meters

Fig. 9-1: Utilization factors

If **either** the ambient temperature **or** the setup elevation exceeds the nominal data:

1. Multiply the motor data provided in the selection data with the calculated utilization factor.
2. Ensure that the reduced motor data are not exceeded by your application.

If **both** the ambient temperature **and** the setup elevation exceed the nominal data:

1. Multiply the determined utilization factors f_T and f_H by each other.
2. Multiply the value obtained by the motor data specified in the selection data.
3. Ensure that the reduced motor data are not exceeded by your application.

9.2 Humidity

Climatic environmental conditions are defined into different classes according to DIN EN 60721-3-3, Table 1. They are based on observations made over long periods of time throughout the world and take into account all supply parameters that could have an effect, such as the air temperature and humidity.

Based on this table, Rexroth recommends class 3K4 for continuous use of the motors.

This class is excerpted in the following table.

Environmental factor	Unit	Class 3K4
Low air temperature	°C	+5 [1])
High air temperature	°C	+40
Low rel. humidity	%	5
High rel. humidity	%	95
Low absolute humidity	g/m³	1
High absolute humidity	g/m³	29
Speed of temperature change	°C/min	0,5
[1]) Rexroth permits 0°C as the lowest air temperature.		

Fig. 9-2: Classification of climatic environmental conditions according to DIN EN 60721-3-3, Table 1

9.3 Vibration and Shock

Vibration

Sinusoidal vibrations occur in stationary use; depending on their intensity, they have different effects on the robustness of the motors.

The robustness of the overall system is determined by the weakest component.

Based on DIN EN 60721-3-3 and DIN EN 60068-2-6, the following values result for Rexroth motors:

Direction	Maximum permitted vibration load (10-2000 Hz)
axial	i.p.
radial	i.p.

Fig. 9-3: Maximum values for sine-shaped vibrations

Shock

The shock load of the motors is indicated by providing the maximum permitted acceleration in non-stationary use, such as during transport.

Damage to functions is prevented by maintaining the provided limit values.

Based on DIN EN 60721-3-3 and DIN EN 60068-2-6, the following values result for Rexroth motors:

Motor frame size	Maximum permitted shock load (6ms)	
	axial	radial
102	i.p.	i.p.
142		
162		
182		
202		
242		
272		
312		
382		

Fig. 9-4: Maximum values for shock stress

⇒ For storage, transport and operation of the motors, ensure that the maximum values in Fig. 9-3 and Fig. 9-4 are not exceeded.

ℹ The construction and effectiveness of shock-absorbing or shock-decoupling attachments depends on the application and must be determined using measurements. This does not lie within the area of responsibility of the motor manufacturer. Modifications of the motor construction result in nullification of the warranty.

9.4 Protection Class

The protection class **IP00** according to IEC 60529:1989 + A1: 2000 applies for the stator and rotor of the IndraDyn H series. The applicability of IndraDyn H motors for certain conditions must be checked carefully.

Note: The machine manufacturer is responsible for testing and execution of suitable measures.

Notice the following list (without any guarantee on completeness).

Difficulties

- Use of the motor in damp environment or a high-humidity atmosphere.
- Use of cooling lubricants, aggressive materials or other liquids.
- Cleaning procedure with high pressures, steam or jets of water.

Possible effects

- Chemical or electro-chemical interaction with subsequent corrosion or decomposition of motor parts.
- Damage of the winding insulation and irreparable damage of the motor.

Possible countermeasures

- Plan suitable covers or seals to protect the motor.

- Use only those cooling lubricants and other materials that have no aggressive or decompose effect on the motor parts.
- Do not clean with high pressures, steam or jets of water.

9.5 Compatibility

All Rexroth controls and drive are developed and tested according to the state of the art.

However, since it is impossible to follow the continuing further development of every material with which our controls and drives could come into contact with our controllers and drive devices (e.g. lubricants on tool machines), reactions with the materials that we use cannot be ruled out in every case.

For this reason, you will have to carry out a compatibility test for new coolants, lubricants, detergents, etc. and our housing and device materials.

9.6 Motor Cooling

Rexroth IndraDyn H frameless motors have a novel cooling circuit that is already incorporated in the motor. The heat of the transformed motor power loss P_V is dissipated by the cooling circuit. IndraDyn H motors may therefore be operated only if the supply of coolant is ensured.

The cooling system must be rated by the machine manufacturer in such a way that all requirements regarding flow, pressure, purity, temperature gradient etc. are maintained in every operating state.

CAUTION

Impairment or loss of motor, machine or cooling system!

⇒ You absolutely must take the motor data in chapter 4 and the explanations of the cooling system concept in the documentation ”Liquid cooling, Dimensioning, Selection”, MNR R911265836 into account.

⇒ Heed the manufacturer instructions when constructing and operating cooling systems.

⇒ Do not use any lubricants or cutting lubricants from operating processes.

⇒ Avoid pollution of the cooling medium as well as modifications of the chemical consistence and of the pH-value.

Used Materials

When used in IndraDyn H-motors, the coolant comes into contact with the following materials:

Motor frame size	Motor	Screwed connections
102.....382	CU	brass

Fig. 9-5: Material contact with coolant

Coolants

All information and technical data are based on water as the coolant. If other coolants are used, these data no longer apply and must be recalculated.

Cooling with running tap water is not recommended. Hard tap water can cause deposits and damage the motor and the cooling system.

For corrosion protection and for chemical stabilization, the coolant water must have an additive which is suitable for mixed installations with the materials copper (cooling lines) and brass (connectors).

IndraDyn H motors can be damaged irreparably by using aggressive coolants, additives and lubricants or by pollution of the coolant.

WARNING

Impairing the cooling effect of damaging the cooling system!

⇒ Adjust coolant and flow to the required motor performance data

⇒ Use systems with closed circuit and a fine filter 100 µm.

⇒ Use a corrosion protection with water as a coolant and maintain the required ratio of mixture.

⇒ Use approved anticorrosion agents, only

⇒ Do not use cooling lubricants from machining process

⇒ Avoid pollution of the cooling medium as well as changes of the chemical consistency and of the pH-value.

⇒ Do not use hard water

⇒ Use a closed cooling circuit

⇒ Adhere to the specified inlet temperatures

⇒ Do not exceed the maximum pressure

⇒ Motor operation without liquid cooling is not allowed

⇒ Heed the environmental protection and waste disposal instructions at the place of installation when selecting the coolant.

Note: The performance test for the used coolants and the design of the liquid coolant system are generally the responsibility of the machine manufacturer.

Aqueous Solution

Aqueous solutions ensure a reliable corrosion protection without significant changes of the physical property of the water. The recommended additives contain no materials harmful to water.

Emulsion with Corrosion Protection

Corrosion protection oils for coolant systems contain emulsifiers which ensure a fine distribution of the oil in the water. The oily components of the emulsion protect the metal surface of the coolant duct against corrosion and cavitation. An oil content of 0.5 – 2 volume percent has proven itself.

If the corrosion protection oil is responsible for not only corrosion protection but also lubricating the coolant pump, an oil content of 5 volume percent is necessary.

⇒ Heed the instructions of the pumping manufacturer!

Description	Manufacturer (Germany)
1%...3%-solutions	
Aquaplus 22	Petrofer, Hildesheim
Varidos 1+1	Schilling Chemie, Freiburg
33%-solutions	
Glycoshell	Deutsche Shell Chemie GmbH, Eschborn
Tyfocor L	Tyforop Chemie GmbH, Hamburg
OZO Frostschutz	Deutsche Total GmbH, Düsseldorf
Aral Kühler-Frostschutz A	ARAL AG, Bochum
BP antifrost X 2270 A	Deutsche BP AG, Hamburg
Emulsifiable mineral oil concentrate	
Shell Donax CC (WGK: 3)	Shell, Hamburg

Fig. 9-6: Recommended coolant additives

Coolant Inlet Temperature

IndraDyn H motors are designed according to DIN EN 60034-1 for operating with a coolant temperature between +10...+40°C. This temperature range must absolutely be maintained. At higher coolant temperatures, the available torque is reduced more and more. Lower coolant temperatures can lead to destruction of the motor because of high temperature gradients.

Note: Install systems in the cooling circuit for monitoring flow, pressure, and temperature.

Setting the inlet temperature

The coolant inlet temperature must be set taking into account the specified temperature range and the existing ambient temperature.

If necessary, the minimum recommended coolant inlet temperature can be limited depending on the existing ambient temperature. To prevent condensation, a temperature of max. 5°C below the existing ambient temperature is permitted as the lowest value that can be set.

Example 1:

Permissible coolant inlet temperature range: +10 ... +40°C

Ambient temperature: 20°C

Coolant inlet temperature to be set: +15 ... +40°C

Example 2:

Permissible coolant inlet temperature range: +10 ... +40°C

Ambient temperature: 30°C

Coolant inlet temperature to be set: +25 ... +40°C

Thermal Behavior

Power loss

The achievable rated torque of an IndraDyn H motor is mainly determined by the power loss P_V that is produced during the energy conversion process. The power loss fully dissipates in form of heat. Due to the limited permissible winding temperature it must not exceed a specific value.

Note: The maximum winding temperature of IndraDyn H motors is 155°C. This corresponds to insulation class F.

The total losses of these kit motors are chiefly determined by the losses in the stator.

$$P_V \approx P_{Vi} = \frac{3}{4} \cdot i^2 \cdot R_{12} \cdot f_T$$

P_V:	Total loss in W
P_{Vi}:	Current heat dissipation in W
i:	Current in motor cable (peak value) in A
R_{12}:	Electrical resistance of the motor at 20°C in Ohm (see chapter 4, “Technical Data”)
f_T:	Factor temperature-related resistance rise

Fig. 9-1: Power loss of IndraDyn H motors

Note: When you determine the power loss according to Fig. 9-7, you must take the temperature-related rise of the electrical resistance into account. At a temperature rise of 115 K (from 20°C up to 135°C), for example, the electrical resistance goes up by the factor $f_T = 1.45$.

Thermal time constant

The temperature variation vs. time is determined by the produced power loss, the heat-dissipation and heat–storage capability of the motor. The heat-dissipation and heat–storage capability of an electrical machine is (combined in one variable) specified as the thermal time constant.

Note: With liquid cooling systems, the thermal time constant is between 5...10 min. (depending on size).

The following Fig. 9-8 shows a typical heating and cooling process of an electrical machine. The thermal time constant is the period within which 63% of the final over temperature is reached. With liquid cooling, the cooling time constant corresponds to the heating time constant. Thus, the heating process and the cooling process can both be specified with the specified thermal time constant (heating time constant) of the motor.

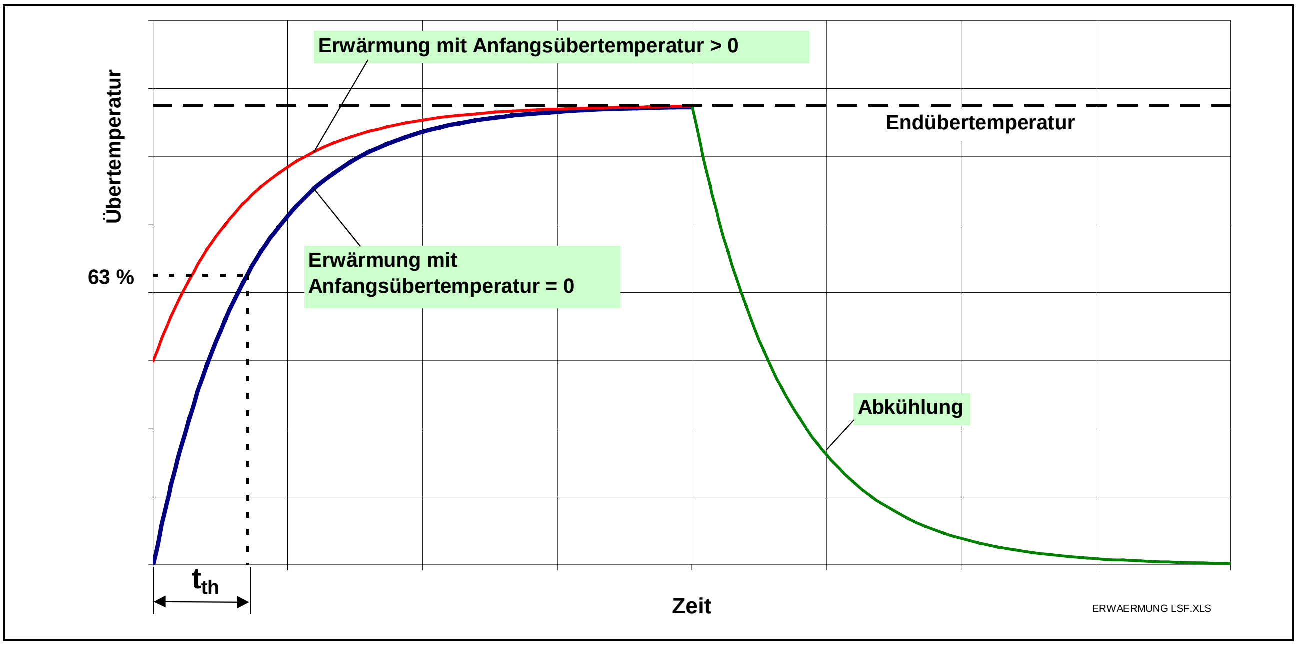
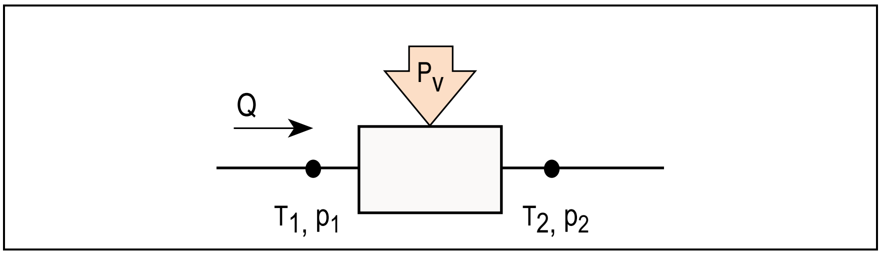


Fig. 9-2: Heating up and cooling down of an electrical machine

Sizing the Cooling Circuit



Q: Flow quantity
T_1: Coolant inlet temperature
T_2: Coolant outlet temperature
p_1: Inlet pressure
p_2: Outlet pressure

Fig. 9-3: Liquid-cooled component

Coolant temperature rise

$$\Delta T = T_2 - T_1$$

T_1: Coolant inlet temperature in K
T_2: Coolant outlet temperature in K
ΔT: Coolant temperature rise in K

Fig. 9-10: Coolant temperature rise in K

Pressure drop

$$\Delta p = p_1 - p_2$$

p_1: Inlet pressure
p_2: Outlet pressure
Δp: Pressure drop

Fig. 9-11: Pressure drop across traversed component

Flow rate

Coolant flow to maintain the rated torque

The coolant flow required to maintain the rated torque is defined in chapter 4, “Technical Data”.

The specification of this value is based on a rise of the coolant temperature by 10 K.

Figures 9-12 and 9-13 are used to determine the necessary coolant flow for different temperature rises and/or different coolants:

$$Q = \frac{P_{co} \cdot 60000}{c \cdot \rho \cdot \Delta T}$$

Q: Required coolant flow in l/min
P_{ro}: Removed power loss in W
c: Specific heat capacity of the coolant in J / kg - K
ρ: Density of the coolant in kg/m³
ΔT: Coolant temperature rise in K

Fig. 9-4: Coolant flow required for removing a given power loss.

Coolant	Specific heat capacity c in J / kg - K	Density ρ in kg/m³
Water	4183	998,3
Thermal oil (example)	1000	887
Air	1007	1,188

Fig. 9-5: Substance values of different coolants at 20°C

Reduction of motor torque with coolants other than water

Assuming the same flow rate, you can estimate the reduction of the allowable motor torque when using coolants other than using formula in Fig. 9-14.

$$k_{cred} = \sqrt{\frac{c_x \cdot \rho_x}{c_w \cdot \rho_w}} \cdot 100\%$$

k_{cred}: Reduction factor of motor torque in percent relating to water
c_w: Specific heat capacity of water in J / kg - K
ρ_w: Density of the coolant in kg/m³
c_x: Specific heat capacity of used coolant in J / kg - K
ρ_x: Density of used coolant in kg/m³

Fig. 9-6: Reduction of motor torque when using coolants other than water

Pressure drop

The flow resistance at the pipe walls, curves, and changes of the cross-section produce a pressure drop along the traversed components (see Fig. 9-9).

The pressure drop, Δp, rises as the flow quantity rises (see Fig. 9-15).

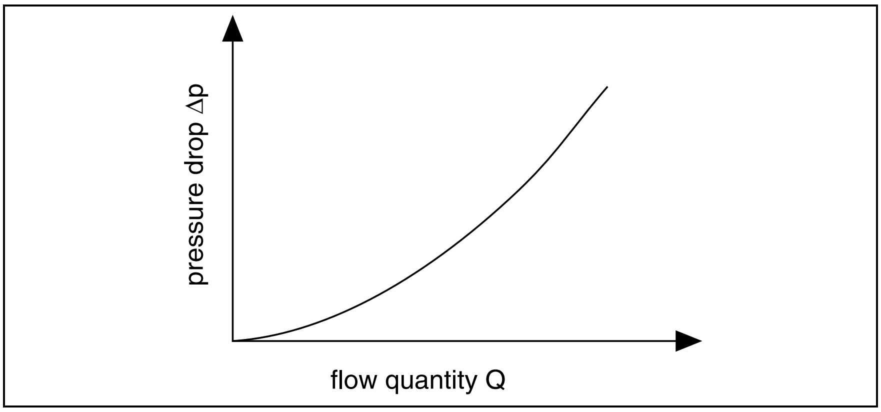


Fig. 9-7: Pressure drop vs. flow quantity; general representation

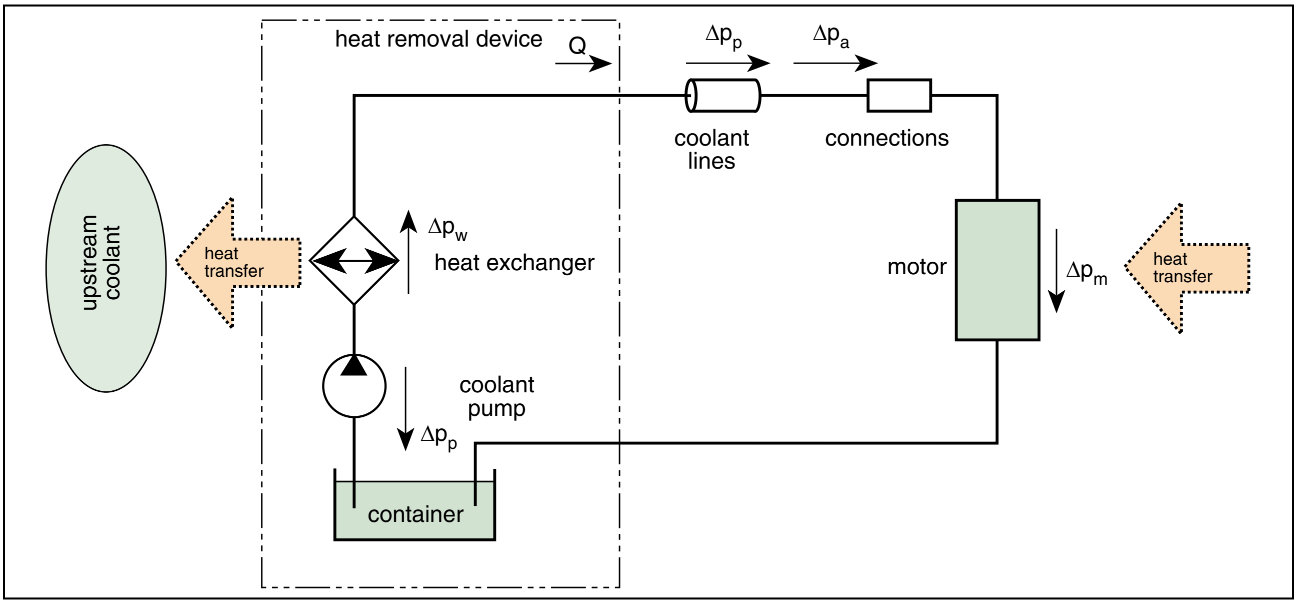


Fig. 9-8: General arrangement of a liquid cooled motor with heat removal facility

Note: The overall pressure drop of the cooling system is determined by various partial pressure drops (motor, feeders, connectors, etc.). This must be taken into account when the cooling circuit is sized.

Liquid Cooling System

Machines and systems can require liquid cooling for one or more working components. If several liquid-cooled drive components exist, they are connected to the heat removal device via a distribution unit.

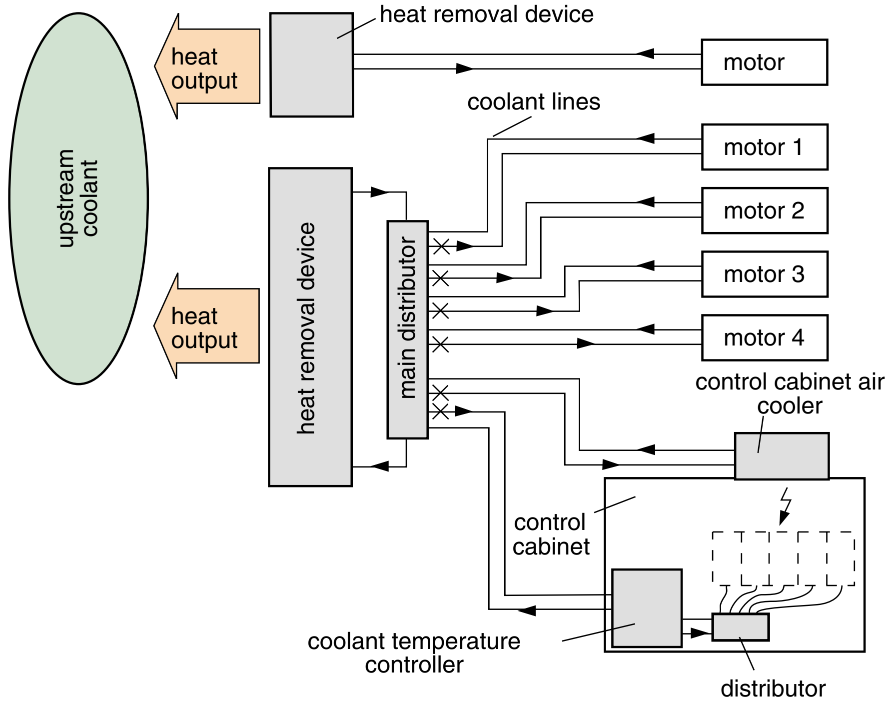


Fig. 9-17: General arrangement of cooling systems with one and more drive components

Heat removal device

The heat-removal device carries off the total heat of all components connected to the cooling system. The heat is transferred to a higher-level coolant which provides a temperature-controlled medium to maintain the required temperature level at the components that are to be cooled.

There are three different types of heat removal devices (see Fig. 9-18). They are identified by the type of the heat exchanger between the different media:

1. **Air-to liquid cooling unit**
2. **Liquid-to-liquid cooling unit**
3. **Cooling unit**

A heat removal device includes a heat exchanger, a coolant pump and a coolant container (see Fig. 9-16).

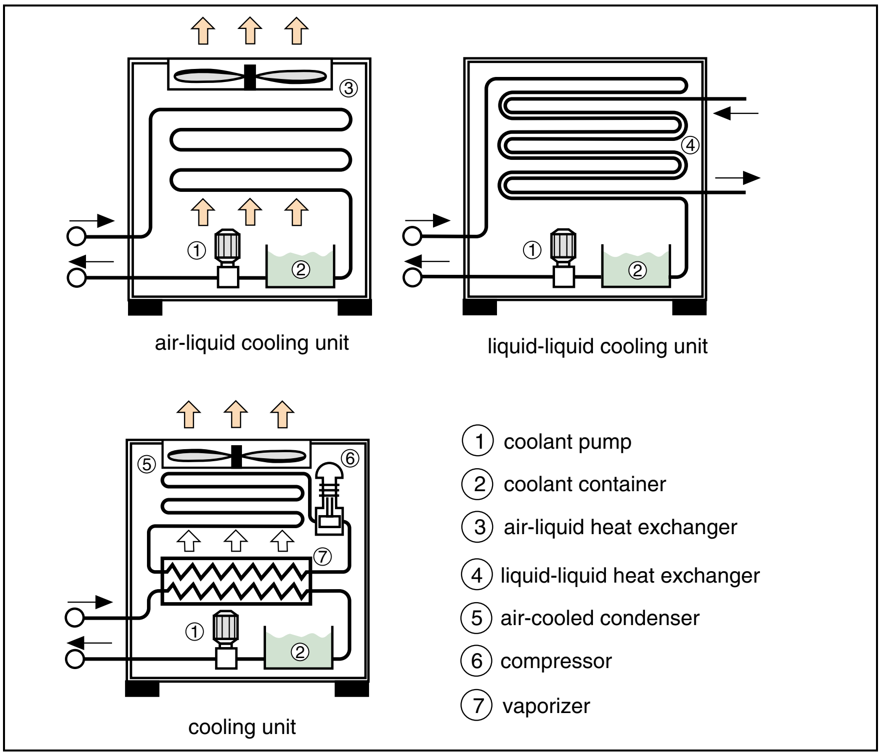


Fig. 9-9: Heat removal devices

	Air-to liquid cooling unit	Liquid-to-liquid cooling unit	Cooling unit
Coolant temperature control accuracy	Low (±5 K)	Low (±5 K)	Good (±1 K)
Secondary coolant circuit required	No	Yes	No
Heating of ambient air	Yes	No	Yes
Power loss recovery	No	Yes	No
Size of the cooling unit	Small	Small	Large
Dependent on ambient temperature	Yes	No	No
Environment-damaging coolant	No	No	Yes
Comments on utilization criteria	Particularly suitable for stand-alone machines that do not have an upstream coolant circuit available and do not have to fulfill high requirements on the stability of the coolant temperature.	This cooling type is particularly suitable for systems with existing central feedback cooler. It does fulfill high require-ments on the stability of the coolant temperature.	Particularly suitable for high requirements on the thermal stability (high-precision applications, for example).

Fig. 9-19: Overview of the heat removal devices according to utilization criteria

Coolant lines

The coolant lines are a major part of the cooling system. They have a great influence on the system´s operational safety and pressure drop. The lines can be made up of hoses or pipes.

The continuous bending strain of the coolant lines must always be taken into account when they are sized and selected.

Further optional components

- Distribution components
- Coolant temperature controllers
- Flow monitors
  A message is output when the flow drops below a selectable minimum flow quantity.
- Level monitors
  Chiefly minimum-maximum level monitor to check the coolant level in the coolant container
- Overflow valves
- Safety valves
  Opens a connection between the coolant inlet and the contained when a certain pressure is reached
- Coolant filters (100 µm)
- Coolant heaters
  To provide coolant of a correct temperature, in particular for coolant temperature control
- Restrictors and shut-off valves

Circuit types

The two possible ways of connecting hydraulic components (series/parallel connection) show significant differences with respect to:

- Pressure drop of the entire cooling system
- Capacity of the coolant pump
- Temperature level and controllability of the individual components that are to be cooled

Parallel connection

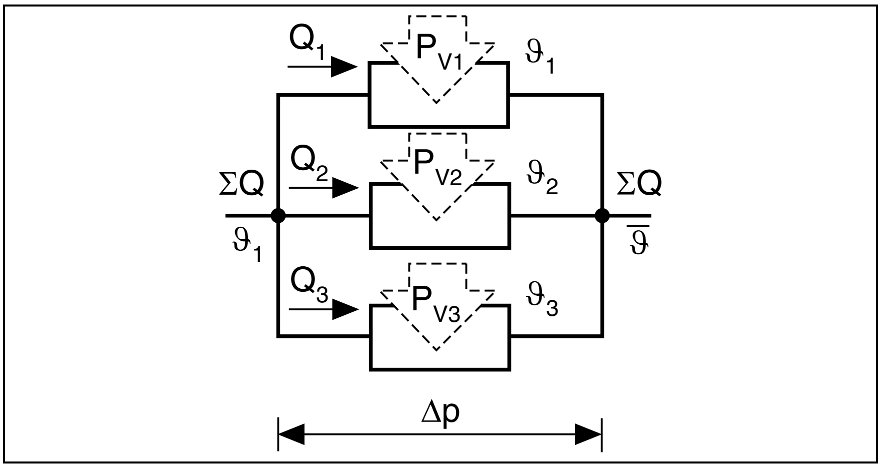


Fig. 9-20: Parallel connection of liquid-cooled drive components

The parallel connection is characterized by nodes in the hydraulic system. The sum of the coolant streams flowing into a node is equal to the sum of the coolant streams flowing out of this node. Between two nodes, the pressure difference (pressure drop) is the same for all intermediate cooling system branches.

$$Q = Q_1 + Q_2 \; \ldots + Q_n$$

$$\Delta p = \Delta p_1 = \Delta p_2 = \Delta p_n$$

Δp: Pressure drop
Q: Flow quantity

Fig. 9-21: Pressure drop and flow quantity in the parallel connection of hydraulic components

When several working components are cooled, a parallel connection is advantageous for the following reasons:

- The individual components that are to be cooled can be cooled at the individual required flow quantity. This means a high thermal operational reliability.
- Same temperature level at the coolant entry of all components (equal machine heating)
- Same pressure difference between coolant entry and outlet of all components (no high overall pressure required)

Series connection

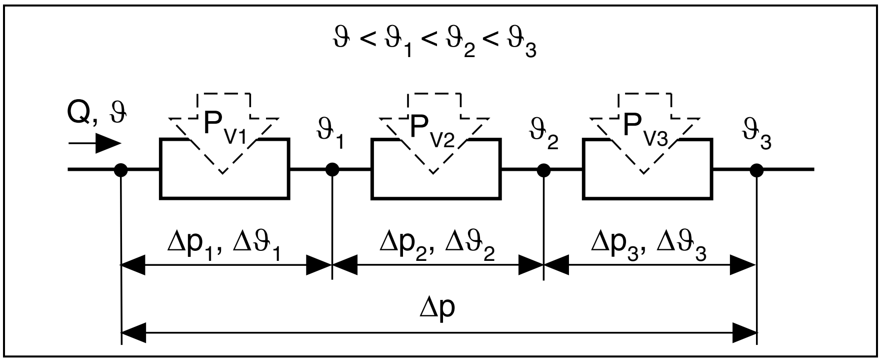


Fig. 9-22: Series connection of liquid-cooled drive components

In series connections, the same coolant stream flows through all components that are to be cooled. Each component has a pressure drop between coolant inlet and coolant outlet. The individual pressure drops add up to the overall pressure drop of the drive components.

Series connection does not permit any individual selection of the flow quantity required for the individual components to be made. It is only expedient if the individual components that are to be cooled need approximately the same flow quantity and bring about only a small pressure drop or if they are installed very far away from the heat removal device.

$$Q = Q_1 = Q_2 = Q_n$$

$$\Delta p = \Delta p_1 + \Delta p_2 \; \ldots \; + \Delta p_n$$

Δp: Pressure drop
Q: Flow quantity

Fig. 9-23: Pressure drop and flow quantity in the parallel connection of hydraulic components

The following disadvantages of series connection must always be taken into account:

- The required system pressure corresponds to the sum of all pressure drops of the individual components. This means a reduced hydraulic operational safety due to a high system pressure.

- The temperature level of the coolant rises from one component to the next. The power loss of each component raises the coolant temperature, so the temperature of the machine is not the same throughout the machine.
- Some components may not be cooled as required since the flow quantity cannot be selected individually.

Combination of series and parallel connection

Combining series and parallel connections of the drive components that are to be cooled permits the benefits of both connection types to be used.

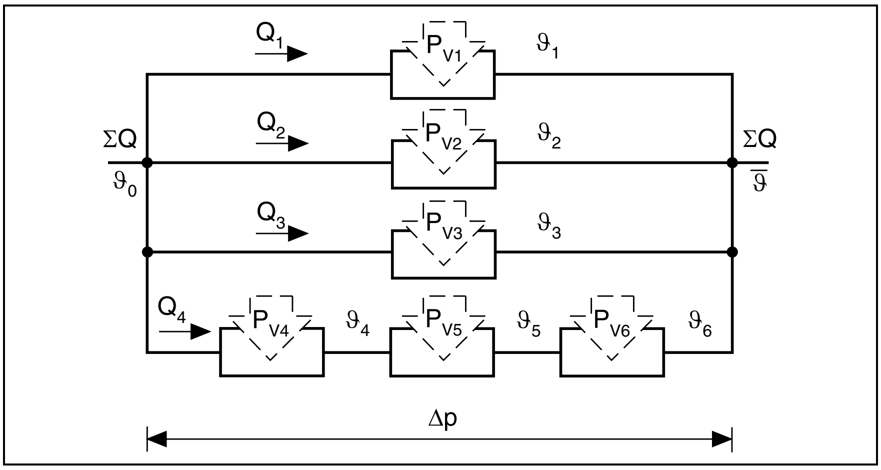


Fig. 9-24: Combination of series and parallel connection

9.7 Motor Temperature Monitor

CAUTION

Failure in the machine or damage by improper use of the sensors!

⇒ The PTC-sensors are not safety devices and are not suited for the integration in safety systems to protect persons or machines.

⇒ The PTC-sensors are neither designed nor suitable for determining the housing, rotor or bearing-temperatures. Additional requirements for the temperature monitor must be implemented by the machine manufacturer.

⇒ The motor is protected from a thermal load only if temperature sensor SNM.150.DK is connected to the drive control device.

In their standard configuration, IndraDyn H motors are equipped with built-in temperature sensors for motor protection. Every motor phase contains of one of three series-connected, ceramic PTCs, which ensure the safe thermal control of the motor in every operation phase. These temperature sensors (referred to as motor protection temperature sensors in the following) have a switching character (see Fig. 9-8) and are monitored on all Bosch Rexroth drive control devices.

Furthermore, all stators are fitted with an additional temperature sensor for temperature monitoring. These sensors (referred to as temperature monitoring sensors in the following) have a nearly linear characteristic curve (see Fig. 9-10).

Motor protection temperature sensor

Type	PTC SNM.150.DK.***
Nominal activation temperature ϑ_{NAT}	150 °C
Resistor at 25°C	≈ 100...250 Ohm

Fig. 9-25: Motor protection temperature sensors

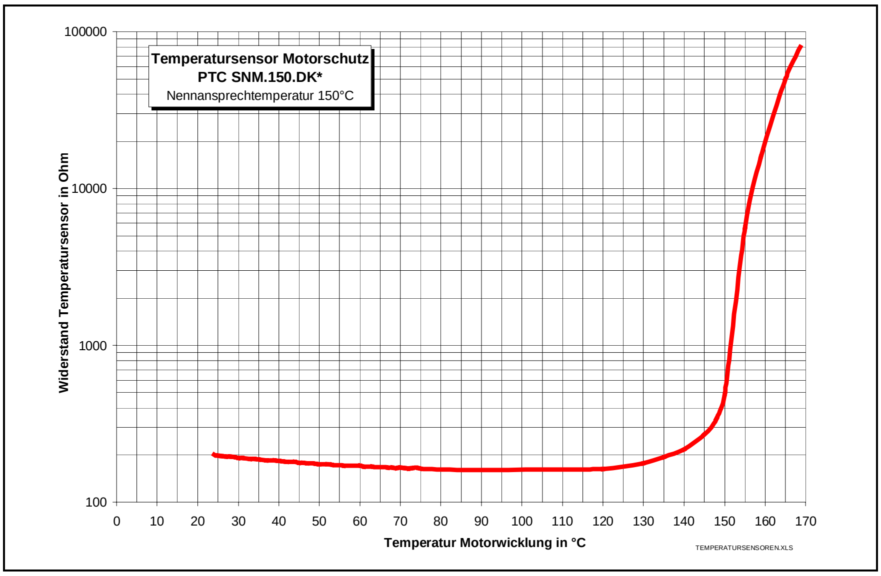


Fig. 9-26: Characteristic curve of motor protection temperature sensors (PTC)

External temperature measurement sensor

Type	KTY84-130
Resistor at 25°C	577 Ohm
Resistor at 100°C	1000 Ohm
Continuous current at 100°C	2 mA

Fig. 9-27: Temperature measurement sensor

Note: When connecting the KTY84-130 temperature sensor, ensure that the polarity is correct (see. chapter 8, “Connection Techniques”).

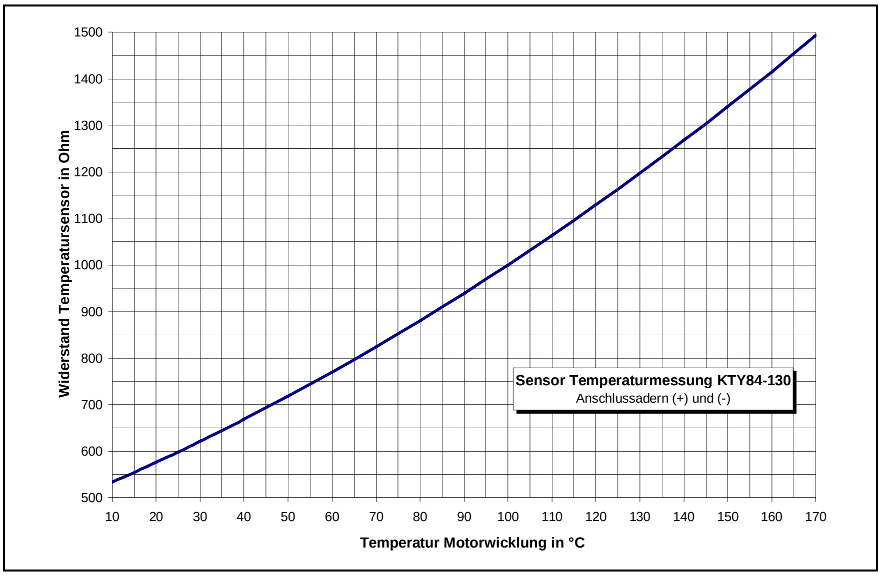


Fig. 9-28: Characteristic curve of the KTY84-130 sensors for temperature monitoring (PTC)

Temperature vs. resistance

$$T_w = A \cdot R_{KTY}{}^3 + B \cdot R_{KTY}{}^2 + C \cdot R_{KTY} + D$$

T_w: Winding temperature of the motor in °C
R_{KTY}: Resistance of the temperature sensor in Ohms
A: $3.039 \cdot 10^{-8}$
B: $-1.44 \cdot 10^{-4}$
C: 0.358
D: -143.78

Fig. 9-29: Polynomial used for determining the temperature with a known sensor resistance (KTY84)

Resistance vs. temperature

$$R_{KTY} = A \cdot T_w{}^3 + B \cdot T_w{}^2 + C \cdot T_w + D$$

T_w: Winding temperature of the motor in °C
R_{KTY}: Resistance of the temperature sensor in Ohms
A: $1.065 \cdot 10^{-6}$
B: 0.011
C: 3.93
D: 492.78

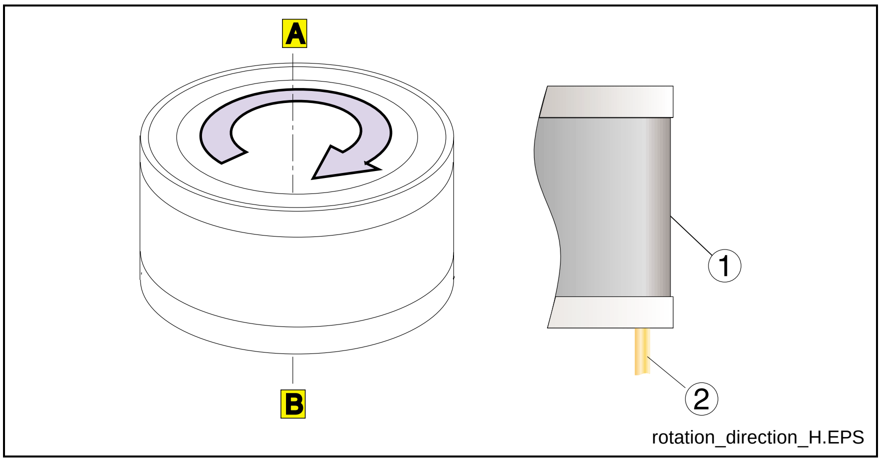
Fig. 9-30: Polynomial used for determining the sensor resistance (KTY84) with a known temperature

You can find further information about connecting temperature sensors in chapter 8, “Connection Techniques”.

9.8 Motor Direction of Rotation

The rotation direction of the motor (rotor direction of rotation) of an IndraDyn H motor is described using the cable outlet side.

The following figure explains the assignment.



(1): Stator
(2): Power leads
Fig. 9-31: Motor direction of rotation

9.9 Design of Rotor and Assembly Principle of Rotor/Spindle Shaft

The rotor and the spindle shaft are connected to one another with a shrink fit. The rotor can be designed in two ways:

- **rotor with smooth bore** (type code designation **1N**)
- **rotor with step interference fit** (type code designation **2N**)

The following descriptions provide an approximate overview of the required assembly steps for connecting the rotor to the spindle shaft. You can find detailed information regarding the assembly of IndraDyn H motors in chapter 11, “Assembly Instructions”.

Rotor with Smooth Bore

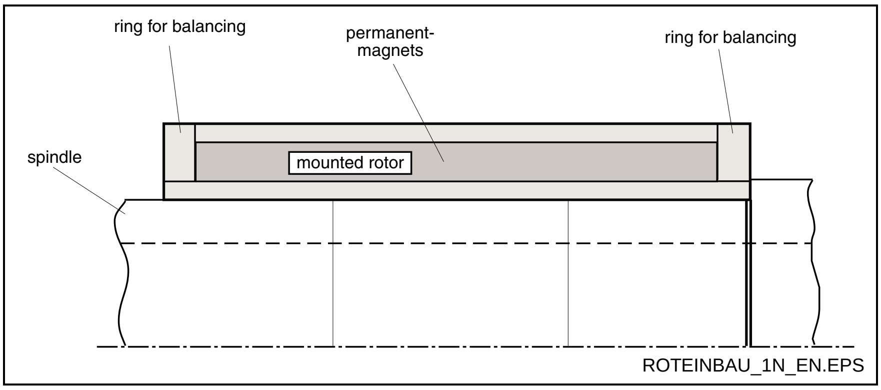


Fig. 9-32: Rotor design 1N – smooth shaft

The rotor consists of a steel sleeve with permanent magnets on the inside. Depending on the rotor type, the spindle has several fitting surfaces arranged next to each other; these have slightly graduated diameter tolerances. The rotor and the spindle are frictionally engaged by the fitting surfaces, which align the assembled rotor to the spindle.

Due to the lack of pressurized oil connection, the advantages of this rotor design over the rotors with a step interference fit include:

- a more compact shape and
- an ability to convert a larger rotor internal diameter within the same amount of space.

The rotor is attached by shrink-fitting it onto the spindle.

The spindle construction in the area of the rotor bore must correspond to the information in the dimension sheets of the corresponding motor in chapter 5.

In this model, the rotor cannot be removed from the spindle without destroying it.

Note: When laying out the motor remember that the rotor with the “1N” design (smooth bore) cannot be removed from the spindle without destroying it after it has been shrink-fitted.

Assembly

Due to the required interference fit, the rotor sleeve must be heated up to 135°C – max. 145°C before assembly.

CAUTION

Damage of the magnets within the rotor due to temperatures above 145°C!

⇒ Heating of the rotor sleeve must be monitored.

⇒ Heating the rotor sleeve above 145°C is not permitted.

Due to the material expansion, the fittings of the rotor bore expand.

At the same time, the spindle must be cooled to –20°C.

The rotor and spindle can then be joined in this state without force.

Dismantling

Note: Disassembly of the rotor with “1N” design (smooth shaft) is not possible!

Balancing

After assembly, the rotor is balanced to the necessary vibration severity grade (EN 60034-14:2004). To achieve equilibrium of the rotor, threaded pins are radial screwed into the circumference of the balancing ring and secured using glue.

Rotor with Step Interference Fit

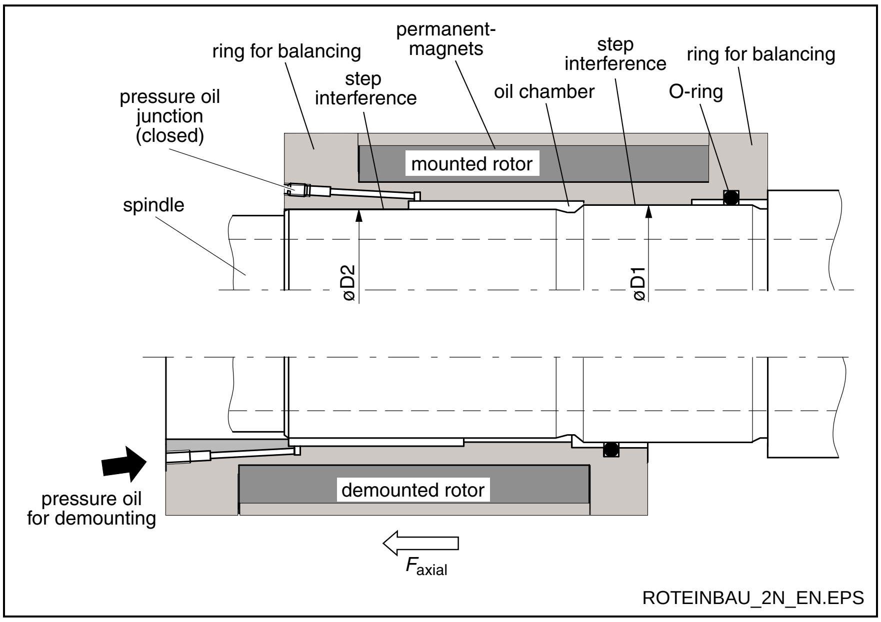


Fig. 9-33: Rotor installation and functional principle of step interference fit

The rotor consists of a steel sleeve with permanent magnets on the inside. The spindle has two fitting surfaces arranged next to each other; these have slightly graduated diameters (øD1 > øD2). The rotor and spindle are frictionally engaged by the step interference fit. The graduated fitting surfaces align the mounted rotor to the spindle; they are required so that the rotor can be removed without damage.

The spindle construction in the area of the step interference fit must correspond to the information in the dimension sheets of the corresponding motor in chapter 5.

The rotor is attached by shrink-fitting it onto the spindle; the oil-pressure procedure is used during removal.

Assembly

Due to the required interference fit, the rotor sleeve must be heated up to 135°C – max. 145°C before assembly. Due to material expansion, the fittings expand to fit diameters D1 and D2.

CAUTION

Damage to the magnets in the rotor due to temperatures over 145°C!

⇒ Heating the rotor sleeve must be monitored

⇒ Heating the rotor sleeve above 145°C is not permitted.

At the same time, the spindle must be cooled to –20°C.

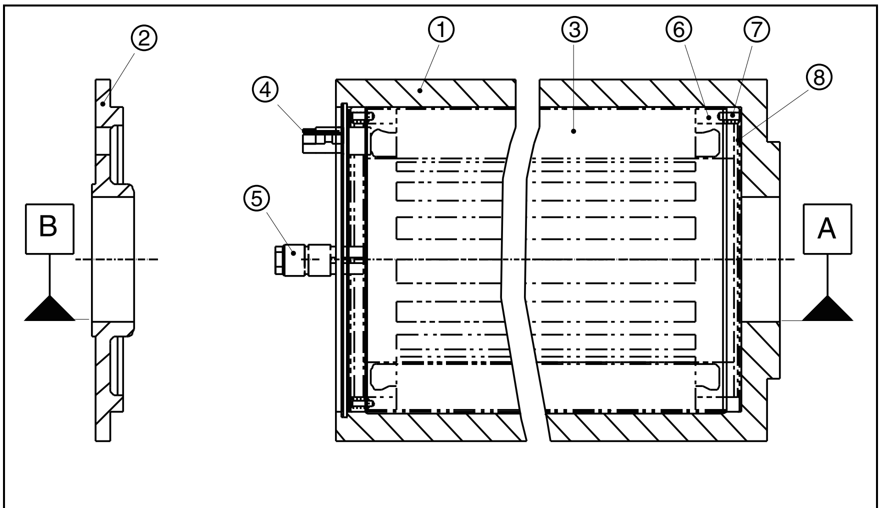
The rotor and the spindle can then be joined without force.

Dismantling

Oil under pressure is injected into the step interference fit during removal. This creates an axial force with which the rotor can slide off the spindle as soon as there is an oil film between the fitting surfaces to separate them. The step interference fit loosens at diameter D1 first. The o-ring keeps the oil from escaping.

Balancing After assembly, the rotor is balanced to the necessary vibration severity grade (EN 60034-14:2004). To achieve equilibrium of the rotor, threaded pins are radial screwed into the circumference of the balancing ring and secured using glue.

9.10 Stator Installation Principles



1:	Spindle housing	2:	End plate
3:	Stator iron core	4:	Power leads
5:	Coolant connection	6:	Stator flange
7:	Stator fastening thread (screw only one stator side on!)		
8:	Gap for longitudinal expansion (take this into account on the opposite side of the stator fastening)		

Fig. 9-34: Stator installation principles

Stator The stator is made up of an iron core with end windings located on the front, two stator flanges and an integrated cooling system.

Construct the mounting bore in the spindle housing according to the dimension sheets of the corresponding motor in chapter 5, “Dimension Sheets”.

Attaching the stator The stator is axially mounted on the corresponding side of the motor spindle; it is then secured against movement. For this purpose, threads for axial attachment have been provided on both ends in the stator flange.

Note: It can be mounted to either the A or B side of the stator, but not on both!

There must be a clearance of at least 1 mm between the stator and the spindle housing on the end opposite of where the stator is attached so that the stator can expand in length. The longitudinal expansion is caused by the stator heating up while the motor spindle is operating

The stator is light in weight and small in size. Therefore, it does not achieve its final flexural strength until it has been built into the spindle housing.

Cooling

IndraDyn H motors have a stator-integrated cooling system. The cooling lines are connected to the A side of the stator using two connectors

Further information for dimensioning and selecting a liquid cooling system is provided in the documentation “Liquid cooling of Indramat drive components”, MNR R911265836.

Corrosion protection

The spindle housing must be protected against corrosion with a suitable corrosion-protection agent.

Electrical connection

The power connection is brought out through the A-side of the stator. There are also at least two PTC thermistors in the end winding which monitor/measure the winding temperature through the control device.

The power leads and the PTC thermistors are guided together with flying leads through a protective sleeve

The grounding connection must be executed according to the information in chapter 8, “Connection Technique”.

When guiding the cable through the spindle housing, note the following:

- the bend radius of the cable must not be less than specified (see chapter 8, “Connection Technique”), and
- the edges of the drill hole in the spindle housing must be rounded off.

9.11 Regenerative Power Uptake

If all motors of a drive package simultaneously enter braking mode (e.g. when all the drives react to an error), it must be ensured that the total regenerative power (motor moment of inertia plus the moment of inertia of the load) can be converted into heat by the power supply or returned to the power supply network.

CAUTION

Material damage due to overload of the braking resistor and to extended braking times / paths!

⇒ Select the power supply device so that the sum of the peak regenerative power of all the drives does not exceed the peak braking resistor power of the power supply device..

In the case of power supply devices that are incapable of regeneration or ones that are capable of regeneration but whose control voltage could fail during an error, the active braking resistor must be capable of taking up the entire regenerated power of a fast braking action!

Calculation

Especially in the case of motors of the IndraDyn H series, the power that is regenerated during braking must be considered due to the high maximum speeds; this power must be compared to the regenerative power uptake of the power supply device/ converter that is used!

Note: If necessary and if possible, an additional braking resistor should be used!

You can find notes regarding calculation of the regenerative power as well as the relevant data of the power supply devices / converters in the documentation for the corresponding Rexroth IndraDrive device, such as

- DOK-INDRV*-HMV-*******, MNR R911299229
- DOK-INDRV*-HCS02.1****, MNR R911306138

9.12 External Components

Motor Encoders

A motor encoder is required for monitoring the position and the velocity of the motor. Particularly high requirements are placed upon the motor encoder and its mechanical connection.

Note: The motor encoder does not belong to the scope of delivery of IndraDyn H motors. The selection of suitable motor encoders must be made by the machine manufacturer and depends on the required application or machine.

For further questions about selection, technical clearance and the compatibility of the motor encoder to Rexroth drive-devices our sales and service facilities (see chapter 13) are available.

To avoid having to go through an autocommutation process each time a synchronous motor switches from parameter mode to operating mode, we typically recommend absolute-encoder systems.

Selection

The attainable precision of IndraDyn H motors depends mainly on the mechanical rigidity of the system as a whole.

Taking into account the desired precision, pay attention to the following additional points when selecting the motor encoder:

- speed range of the motor
- speed range of the encoder
- encoder resolution
- compatibility to the control device

Measuring principles

Absolute encoder

The advantages of an absolute encoder system include:

- high availability of the axis of motion and
- high reliability of the axis of motion

Further advantages are:

- Monitoring and diagnosis functions of the electronic drive system are possible without any additional wiring

- The maximum available motor force is available right after switch-on.
- No referencing is required
- Simple startup is possible
- Commutation adjustment is only required for initial commissioning

Note: Using an absolute encoder system makes it possible that the commutation of the motor need only be performed once for initial commissioning.

Incremental encoder

Using an incremental encoder, the pole position must be detected at every time the drive device is turned on. This is done, using a drive-internal procedure that must be executed whenever the motor is switched on. After this, a force processing of the motor is possible.

Note: With incremental encoder systems, the drive-internal procedure for commutation must be executed upon each switch-on.

You can find further details to the particular encoder types in the appropriate publications of the encoder manufacturer.

Suppliers of encoder systems are, for example:

Components	Supplier
ER... Angle measuring instruments	**DR. JOHANNES HEIDENHAIN GmbH** Dr.-Johannes-Heidenhain-Str. 5 83301 Traunreut Tel.: +49 (0) 86 69 31 – 0 Fax: +49 (0) 86 69 50 61 Internet: www.heidenhain.de
RESR angle measuring systems	**RENISHAW GmbH** Karl-Benz-Strasse 12 72124 Pliezhausen Tel.: +49 (0) 71 27 / 98 10 Fax: +49 (0) 71 27 / 88 23 7 Internet: www.renishaw.com
GEL... gear encoder	**Lenord, Bauer &Co.GmbH** Dohlenstrasse 32 D-46145 Oberhausen Tel.: +49 (0) 208 / 9963 – 0 Fax: +49 (0) 208 / 6762 – 92 Internet: www.lenord.de

Fig. 9-35: Motor encoder suppliers

Bearings

Note: Bearings do not belong to the scope of delivery of IndraDyn H motors. The selection of the required bearings depends on the demands of the application or machine.

Selection

Taking into account their lifetime, pay attention to the following when selecting bearings:

- the speed range of the motor and
- the radial and axial loads on the bearing during operation.

You can find detailed notes on selecting bearings in the corresponding publications of the bearing manufacturers.

Suppliers for bearings include.

Components	Supplier
YRT... bearing	**INA-SCHAEFFLER KG** Industriestrasse 1-3 D-91074 Herzogenaurach Tel: +49 (0) 91 32 / 82 - 0 Fax: +49 (0) 91 32 / 82 - 49 50 Internet: www.ina.de
Bearing ...	**SKF GmbH** Gunnar-Wester-Strasse 12 D-97421 Schweinfurt Tel: +49 (0) -9721 -56 -0 - 0 Fax: +49 (0)-9721-56-6000 Internet: www.skf.com
Bearing ...	**NSK Deutschland GmbH** Hauptverwaltung Harkortstrasse 15 D-40880 Ratingen Tel: +49 (0) -21 -4810 -0 - 0 Fax: +49 (0)-21-02-4812290 Internet: www.nsk.com
Bearing ...	**NTN Wälzlager GmbH** Max-Planck-Strasse 23 D-40699 Erkrath Tel:+49 (0)-211-2508-0 Fax: +49 (0)-211-2508-400 Internet: www.ntn-europe.com

Fig. 9-36: Bearing suppliers

10 Handling, Transport and Storage

10.1 General

Heed the different weights and sizes of the separate motor designs when selecting the transport and lift equipment. Specifications on weight of rotor and stator can be found in the data sheets of the particular motors in chapter 4, “Technical data”.

Even the manually-transportable sizes must be handled with the greatest care and the appropriate transport and storage instructions have to be heeded.

10.2 Delivery Status

Depending on their size, IndraDyn H motors are packed in cardboard boxes with polystyrene peanuts or in wooden crates.

The goods are delivered on a pallet or in a box. Units on pallets are secured by bandages.

Rotor and stator are separately packed so that they are protected against damage during transport.

If several motors or components are ordered together, they are packed together into one package, if possible.

An envelope with the delivery note is fixed to the wooden crates or on the cardboard boxes, .

The following labels are fixed on the package:

- one label with notes regarding safe handling
- one label with instructions for safe delivery
- barcode label (quantity depends on the content) with details about:
    - customer
    - delivery note
    - consignment
    - forwarding agent ordered

Unless requested, no further documents are supplied.

WARNING

Injuries due to uncontrolled movement of the bandages when cutting!

⇒ Observe sufficient distance.

⇒ Remove the bandages carefully.

CAUTION

Risk of injury and - or damage when using IndraDyn H rotors!

⇒ Strictly observe and adhere to the warnings and safety instructions

⇒ Sign the working space as containingdangerous magnetic fields.

⇒ Due to their strong magnetic fields, do not unpack the rotors straight before mounting.

Factory Test

All IndraDyn H-motors undergo the following tests, among others, at the factory:

- High-voltage test according to EN 60034-1 (= VDE 0530-1).
- Insulation resistance according to EN 60204-1/1.92, Section 20.3.
- Geometric measurement of all mounting sizes.

Test on the Customer Side

Since all IndraDyn T-motors undergo a standardized inspection procedure, high-voltage tests on the customer side are not required. Motors and components could be damaged if they undergo several high-voltage tests. Should additional tests be done, please contact Bosch Rexroth.

CAUTION

Destruction of motor components by improperly executed high-voltage test! Invalidation of warranty!

⇒ Avoid repeated inspections.

⇒ Observe the regulations of EN 60034-1 (= VDE 0530-1).

Scope of Delivery

The total scope of delivery can be seen in the delivery note or the waybill. The content, however, can consist of several packages. Each individual package can be identified using the shipment label attached to the outside.

For both stator and rotor is an individual name plate with unit marking and technical details as well as a supply note with information for handling attached.

in preparation

Fig. 10-1: Scope of delivery

⇒ After receiving the goods, compare the ordered and the supplied type. Submit claims concerning deviation immediately.

10.3 Identification

Barcode label

For every rotor and stator, a barcode label is affixed to the package. The barcode label serves to identify the content of the packages and is necessary for order processing.

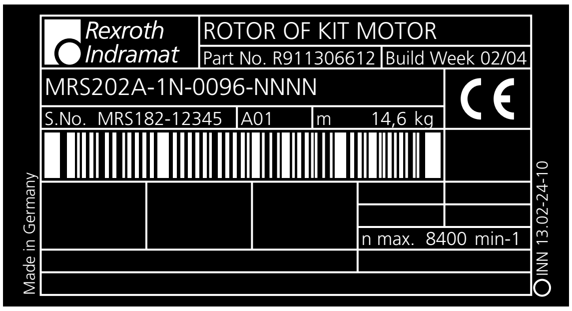
Name plate

Both stator- (MSS) and rotor (MRS) components are delivered with one type plate each.

Attach the name plates to an easily visible portion of the machine. In this way, you can read the motor data at any time without having to work in areas that are difficult to access.

Before sending questions to BOSCH REXROTH, always note the full type identification data and serial number of the affected products.

Rotor



Typschild MRS.EPS

Fig. 10-2: Example of a rotor-name plate

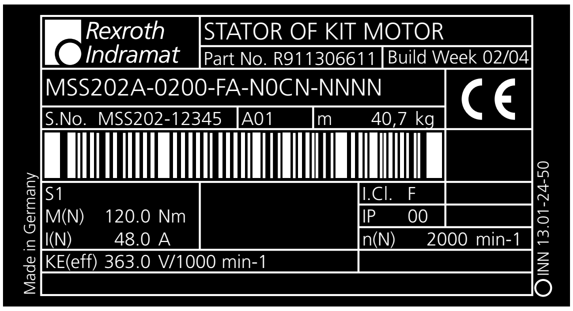
The following data are engraved on one face of each rotor

- Type designation
- Serial No.
- Year and month of production

in preparation

Fig. 10-3: Example of type designation on the rotor

Stator



Typschild MSS.EPS

Fig. 10-4: Example of a stator-name plate

The following data are engraved on-side of the stator which has the electrical connections:

- Type designation
- Serial No.
- Year and month of production

in preparation

Fig. 10-5: Example of type designation on the stator

10.4 Transport and Storage

Also observe the notes regarding storage and transport on the packages. Provide signage in the work space and the place of storage to clearly indicate the presence of magnetic fields.

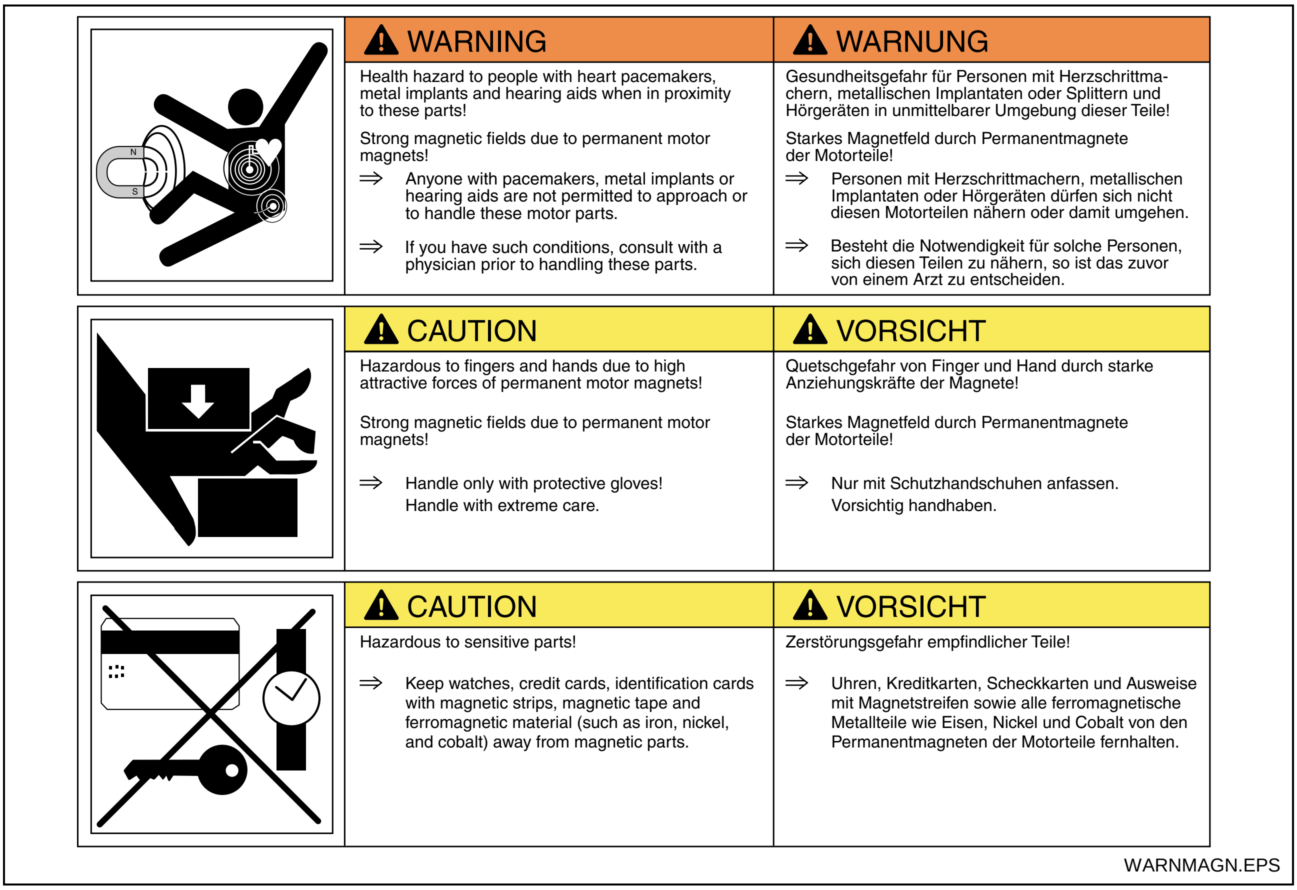


Fig. 10-6: Warning sign

Note: The self-sticking warning label shown in Fig. 10-6 (sizes approx. 110mm x 150mm) can be ordered from Rexroth (MNR R911278745).

CAUTION

Damage or injuries and invalidation of the warranty due to improper handling!

⇒ **Strict compliance of all safety notes and warnings**

⇒ Protect the products from dampness and corrosion

⇒ Avoid mechanical stressing, strokes, throwing, tipping or dropping of the products.

⇒ Use only suitable tackles.

⇒ Do never pick up a motor on the connectors, cables or connection thread.

⇒ Use suitable protective equipment and protective clothing during transport.

⇒ Sign your working space according to the warnings in Fig. 10-6.

⇒ Store rotor and stator in the original packaging under dry, shock-free, dust-free and corrosion-protected conditions. Permitted temperature range –20°C to +80 °C.

Transport

CAUTION

Damage or injuries and invalidation of the warranty due to improper handling!

⇒ **Strict compliance of all safety notes and warnings**

⇒ Protect the products from dampness and corrosion

⇒ Avoid mechanical stressing, strokes, throwing, tipping or dropping of the products.

⇒ Use only suitable tackles.

⇒ Do never pick up a motor on the connectors, cables or connection thread.

⇒ Use suitable protective equipment and protective clothing during transport.

⇒ Provide signs in your work space according to the warnings in Fig. 10-4.

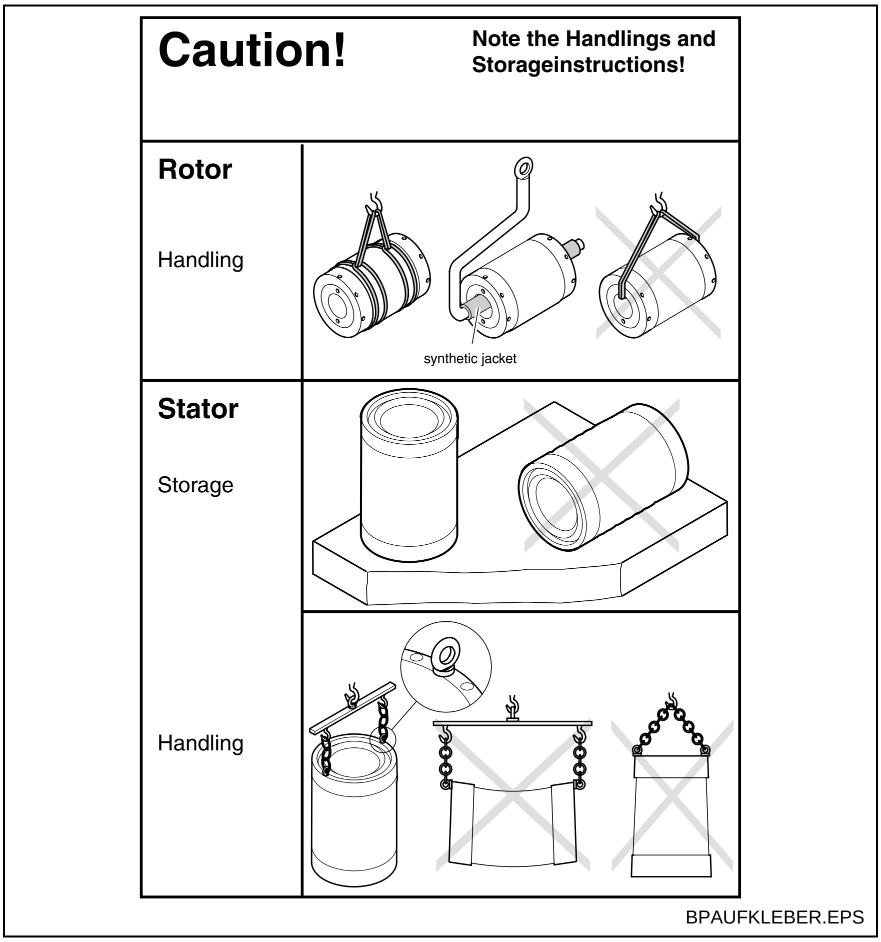


Fig. 10-7: Transport IndraDyn H

Note:

- Use ring screws for transport only in opposite borings. Use only suitable tackles.
- Set down the motor down only on a clean, straight base in a standing position.
- To make mounting easier, avoid damaging the fit on the stator flanges.
- Due to the strong magnetic forces in the rotor, the table (or shelf) and materials used to secure the rotor should be made of nonmagnetic materials.

Storage

Bosch Rexroth recommends storing the rotor and the stator in their original packaging to protect them against dirt and damage.

Before you store or ship the parts, remove all of the coolant and other contaminants.

VORSICHT

Damage or injuries and invalidation of the warranty due to improper handling!

⇒ Avoid mechanical stressing, strokes, throwing, tipping or dropping of the products.

⇒ Provide a sufficient amount of signs in your storage area according to the warnings in Fig. 10-4.

⇒ Store rotor and stator in the original packaging under dry, shock-free, dust-free and corrosion-protected conditions.

⇒ Permitted temperature range –20°C to +80 °C.

---

11 Assembly Instructions

In addition to providing technical characteristics, this chapter describes how

- the rotor is mounted to the spindle,
- the rotor is removed from the spindle,
- the stator is installed in the spindle housing,
- the stator is removed from the spindle housing,
- the rotor package is installed in the stator package.

Carefully executing the steps described here will ensure:

- proper and safe assembly and disassembly of the constructional parts,
- the proper functioning of the frameless spindle motor

Notes regarding safety

The notes regarding safety listed in chapter 3 and in this chapter must absolutely be heeded. They help to prevent accidents and damage to materials resulting from improper handling.

Additionally, special notes regarding safety are listed in the assembly guidelines. These can be found where there is increased danger or where it could possibly occur.

Obligation

The basic procedures for mounting and removing the components is always the same. The procedure can vary, however, from that described here, depending on the construction of the spindle and its housing. These assembly instructions are therefore simply general in nature and must be adapted to suit the given demands. The assembly instructions of the manufacturer of the spindle and of the spindle housing are binding and have priority over the procedure described here.

Assembly steps

The procedures depicted below offer an overview of the individual assembly steps.

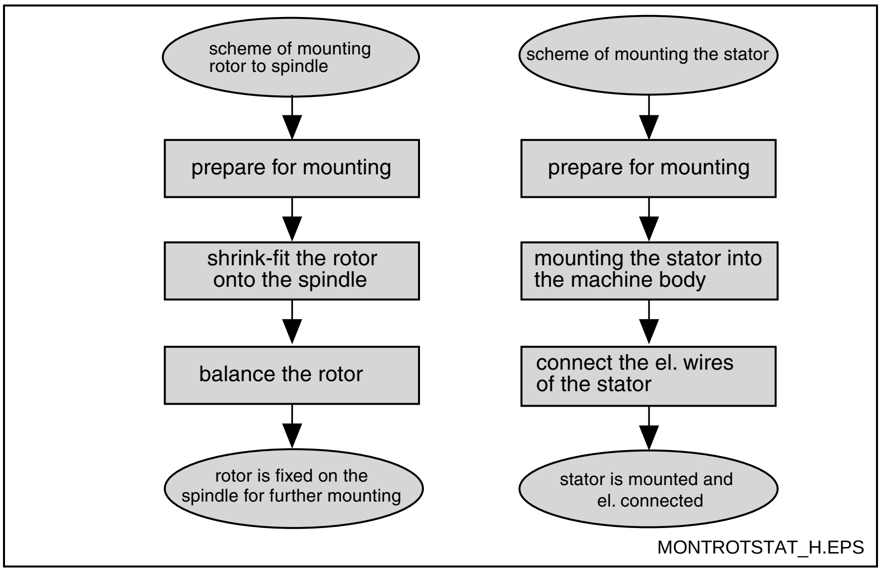


Fig. 11-1: Procedure for assembling the rotor and the stator

11.1 General Notes Regarding Safety

General notes regarding safety in addition to those in chapter 3 "Notes Regarding Safety" are listed in this chapter.

General

- Pay attention to the strong magnetic field surrounding the rotor. Remove the rotor from the original packaging just before assembly.
- Keep the rotor away from ferromagnetic bodies (e.g. tools, metal workbenches, etc.)

Work clothes

During assembly, wear appropriate industrial safety materials such as

- protective goggles
- protective gloves and
- work clothes to protect from high and low surface temperatures and leaking oil.

Work area, handling and transport

Liberally mark your work area according to the warnings in Fig. 10-4 and heed the handling and transport regulations in chapter 10 "Handling, Transport and Storage".

Accident prevention

Heed the accident prevention guidelines "Electrical Installations and Resources" (VBG 4):

Prior to working on live parts in electrical systems and on electrical equipment, disconnect the power and make sure it cannot be reconnected while work is being carried out. Prior to the initial start-up, the electrical systems and electrical equipment must be checked by a qualified electrician to see if they function.

The user is responsible for proper grounding of the entire system. To prevent accidents, protective measures must be taken against direct and indirect contact with live parts. See the notes in DIN VDE 0100, Part 410.

Emergency tools

Ensure that emergency tools, such as wedges (10°-15° wedge angle) and a hammer made of nonmagnetic material is on hand to separate tightened equipment.

Oil pump

When dismantling a rotor with the "step interference fit" design from the spindle, only **manually operated** oil pumps may be used. Manually operated oil pumps guarantee that the oil pressure will immediately drop to 0 bar in the event of leaks in the step interference fit, the windings or the pump piping system. For safety reasons, the oil pump must be additionally equipped with a safety valve which prevents the oil pressure from rising above 1500 bar.

Securing the threaded pins

The threaded pins in the rotor must be secured to keep them from loosening during operation and thereby endangering both machinery and personnel. Glue the threaded pins with LOCTITE for this purpose. See the gluing guidelines in section 11.3.

11.2 Aids for Assembly and Disassembly

Tools and equipment	Mount rotor to spindle	Dismount rotor from spindle	Mount stator	Elec. test of motor spindle	Remove stator
Crane (size sufficient for weight of part)	x	x	x		x
Lifting device (sufficient size for weight of part)	x	x	x		x
Work fixture for attaching rotor 1)	x				
Warming cupboard (+150°C minimum)	x				
Refrigerator (-20°C)	x				
Balancing equipment	x				
Test assembly to check concentricity	x				
Clamping device for fixing spindle-rotor 1)	(x)				
Compressed air deviced	(x)				
Oil pump (max. 1500bar) with accessories 1)	(x)	x			
Arresting device 1)		x			
Drilling device			x		
Water pump to check tightness (up to 6 bar)			x		
Ohmmeter				x	
High-voltage testing equipment				x	
Inductance measuring equipment				x	
Torque wrench up to 35Nm			x		
Conventional tools and cleaning equipment	x	x	x		x
Aids					
LOCTITE 243			x		
LOCTITE 620	x				
LOCTITE quick clean 7061	x		x		
LOCTITE activator 7649	x		x		
Mineral oil: viscosity 300 mm²/s at 20°C	(x)				
Mineral oil: viscosity 900 mm²/s at 20°C		x			
Oil, conventional type, for lubrication	x				
Grease, conventional type	x		x		
Vaseline			x		
Coolant			x		

1) **See explanations on next page.**
(x) **Only applies to mounting errors**

Hilfsmittel.EPS

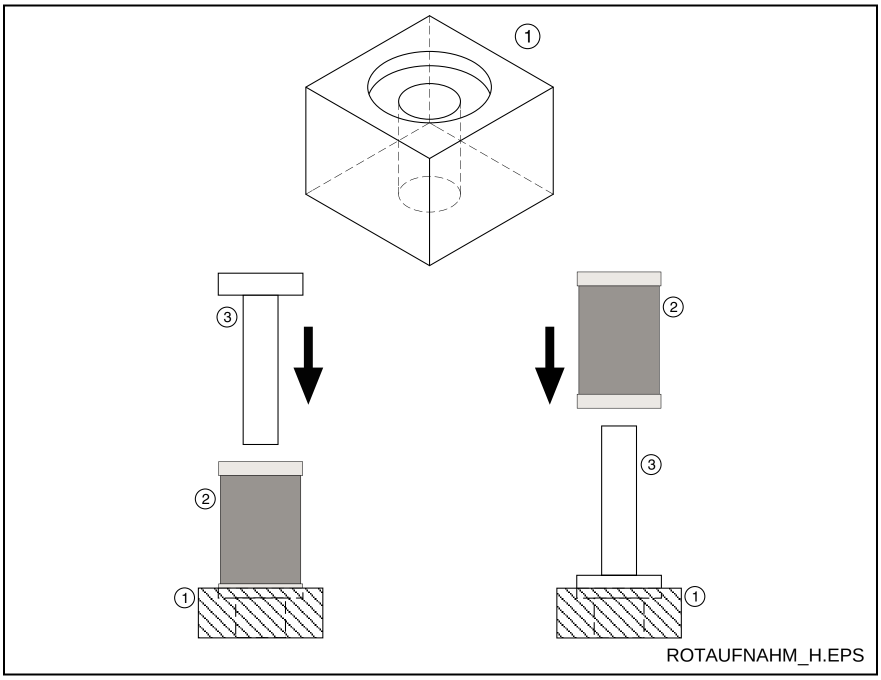
Fig. 11-2: Aids for assembly/disassembly

Note: Use only suitable tools and equipment!

Explanations

Fixture for mounting the rotor:

The fixture must be heat-resistant up to at least +150°C; it must also be able to support the weight of both the rotor and spindle. In addition, it must be made of non-ferromagnetic material and the rotor or spindle must create a level and horizontal surface for the rotor. An example for such a design is shown below.



1: Mounting device
2: Rotor
3: Spindle

Fig. 11-3: Mounting device principle

Manually operated oil pump and accessories:

Oil pressure: 1500 bar with safety valve; connection winding of the high-pressure hose: M4x0.5 or M6 (depending on the rotor type)

Oil pumps and accessories can usually be obtained from the manufacturers of roller bearings.

Clamping device for spindle-rotor attachment:

If the spindle is deformed once the rotor with the step interference fit has been fitted by shrinking, then a clamping device, among other things, is needed to correct this deformation. This device must firmly hold the rotor in place on the spindle and prevent any axial movement of the rotor. Fig. 11-14 illustrates an example.

Arresting device:

When removing the rotor with the step interference fit from the spindle, it can suddenly slide off of the spindle. The spindle must therefore be equipped with an arresting device. Fig. 11-16 illustrates an example. The dimensions of the arresting device must be noted (see Fig. 11-17).

11.3 Securing Screws with LOCTITE [1)]

General

LOCTITE is a plastic gluing agent that is applied in liquid form to the parts to be assembled. The adhesive remains liquid as long as it is in contact with oxygen. Only after the parts have been mounted does it convert from its liquid state into hard plastic. This chemical conversion takes place under exclusion of air and the produced metallic contact. The result is a form-locking connection. It is resistant to shocks and vibrations.

The hardening accelerator Activator 7649 reduces the hardening time of the adhesive.

LOCTITE 620 is heat-resistant up to +200°C, LOCTITE 243 up to +150°C.

Gluing

Proceed as follows:

1. Clean metal chips and coarse dirt from the threaded hole and screw or grub screw.
2. Use LOCTITE rapid cleanser 7061 to clean oil, grease and dirt particles from the threaded hole and screw/grub screw. The threads must be absolutely rust-free.
3. Spray LOCTITE activator into the threaded hole and let it dry.
4. Use LOCTITE adhesive to moisten the same threaded hole in its entire thread length thinly and evenly.
5. Screw in the matching screw/grub screw.
6. Allow the glue to harden. Heed the setting times in Fig. 11-4.

Securing screw connections with LOCTITE in tapped blind holes:

The adhesive must always be dosed into the tapped hole, never on the screw. This prevents the compressed air from extruding the adhesive when the screw or grub screw is screwed in.

	Hardened	Hard to the touch without activator	Hard to the touch with activator 7649
LOCTITE 243	~ 12h	15-30 min	10-20 min
LOCTITE 620	~ 24h	1-2h	15-30 min

Fig. 11-4: Setting times for LOCTITE glues

Detach the connection

To detach the connection, use a wrench for unscrewing the screw or grub screw in the traditional way.

LOCTITE 620 has a breakaway torque of 20-45 Nm; for LOCTITE 243 it is 14-34 Nm (acc. to DIN 54 454). Blowing hot air on the screw connection reduces the breakaway torque.

After the screw / threaded pin has been removed, it is necessary to remove any gluing agent residue from the hole (e.g., by shaving the thread).

[1)] This section has been checked by LOCTITE, Germany for accuracy and approved for publication.

11.4 Assembling a Rotor with a Smooth Shaft on the Spindle

Parts / Scope of Delivery of the Rotor with a Smooth Shaft

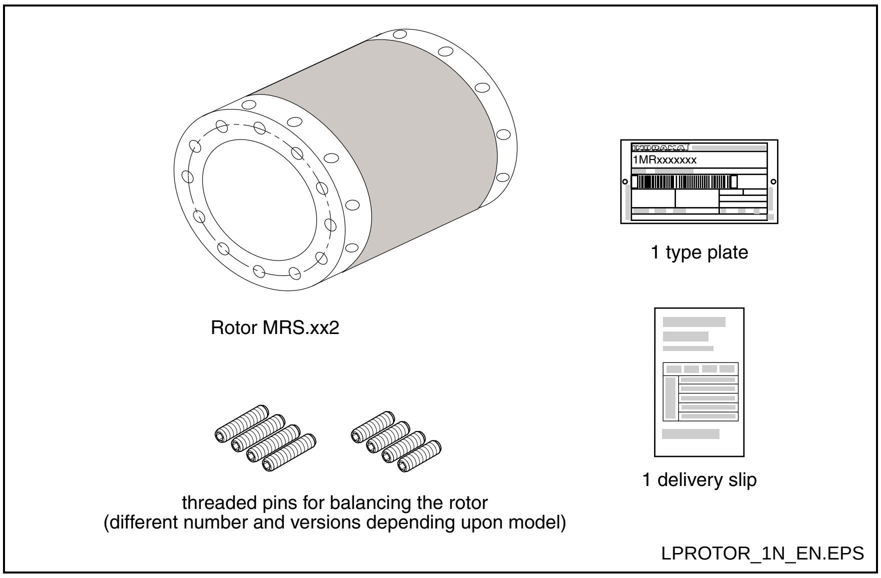


Fig. 11-5: Scope of delivery of the rotor with design 1N

Before Assembly

Assembly should be carried out in a dry, dust-free environment. The following preparatory measures should be taken for this purpose:

- Check to see whether all parts of the delivery are present
- Visually check the rotor for any damage.
- Mount the type plate in a conspicuous position on the spindle housing.
- The inside diameter of the rotor and the press fits on the spindle must be thoroughly cleaned of dirt, dust and metal shavings.
- Oil the press fits on the spindle.

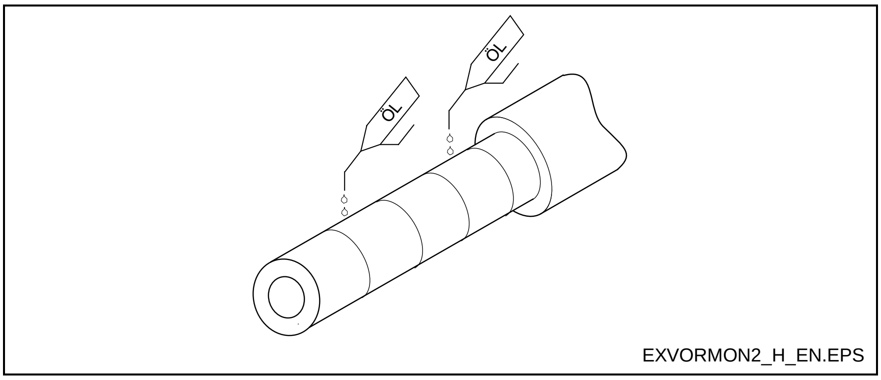


Fig. 11-6: Preparing the spindle for assembly

- Prepare the work fixture for the rotor so that the rotor is supported vertically and can take up the spindle.

Shrink-fitting the Rotor onto the Spindle

1. Carefully heat the rotor in the heating cabinet to at least +135°C, but no more than 145°C.

Note: If the rotor is not heated to at least +135°C, it is possible for the spindle to get stuck in the rotor during the shrink-fitting process before reaching its final position.

WARNUNG

Burns due to hot components with temperatures above 50°C!

⇒ The rotor is hot! Contact leads to serious burn injuries!

⇒ Wear heat-resistant work clothing and heat-resistant gloves!

2. Cool the spindle to -20°C.

Note: If the spindle is not cooled to at least -20°C, it is possible for the spindle to get stuck in the rotor during the shrink-fitting process before reaching its final position.

WARNUNG

Injuries due to supercooled parts with temperatures down to -20°C!

⇒ The spindle is cold!

⇒ Wear suitable protective clothing and safety gloves!

3. Place the rotor into the prepared work fixture.
4. Pick the spindle up and quickly slide it into the rotor.

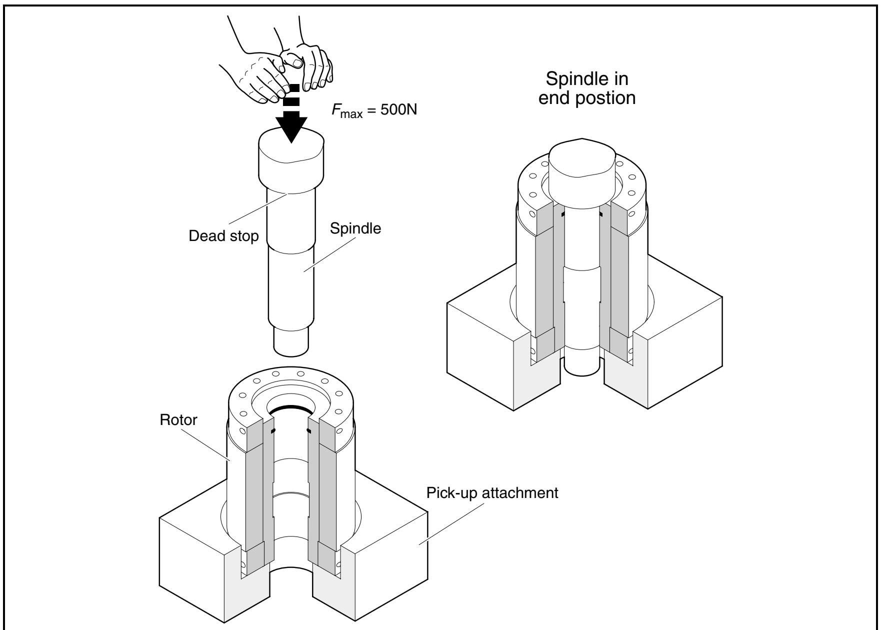


Fig. 11-7: Assembling the rotor and spindle

The spindle usually slides into its end position (final stop on spindle) without requiring additional force. If it does not slide into its end stop by virtue of its own weight, the spindle can be forced into place in the rotor with no more than 500 N (the force equal to the body weight of the mechanic).

5. Let the rotor and spindle cool to room temperature.
6. Check whether the rotor has properly shrunk onto the spindle:
   - Visually check whether the spindle is in its final position in the rotor
   - Check the concentricity of the spindle:

   Check whether the concentricity of the spindle is still as high as it was prior to shrink-fitting. If the concentricity has deteriorated, the spindle is slightly deformed. This deformation is caused by stress which can occur in the parts during cooling.

Note: If the spindle is not in its final position and the necessary concentricity can not be achieved, the measures described in the “Measures to be Taken in the Case of Faulty Assembly” section (below) must be taken.

11.5 Assembling a Rotor with a Step interference fit on the Spindle

Parts / Scope of Delivery of the Rotor with a Step interference fit

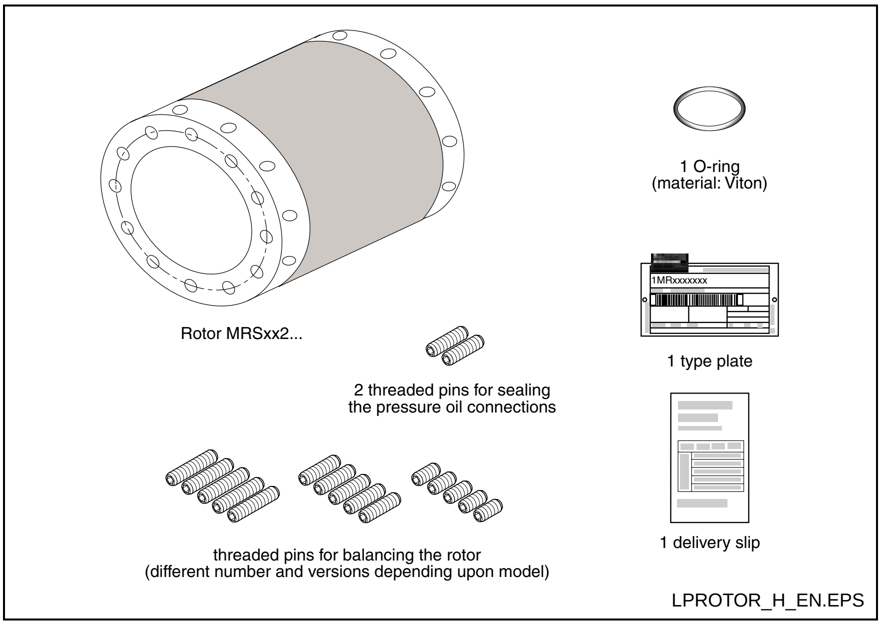


Fig. 11-8: Scope of delivery of the rotor with design 2N

Before Assembly

Assembly should be carried out in a dry, dust-free environment. The following preparatory measures should be taken for this purpose:

- Check to see whether all parts of the delivery are present.
- Visually check the rotor for any damage.
- Mount the type plate in a conspicuous position on the spindle housing.
- Make sure that the bevels and edges of the spindle press fits are free of burrs. Remove burrs if necessary.
- The inside diameter of the rotor, the oil connection drill holes and the press fits on the spindle must be thoroughly cleaned of dirt, dust and metal shavings.
- Lubricate the O-ring and insert it into the groove in the rotor. Do not twist the O-ring! Make sure everything is clean.
- Oil the press fits on the spindle.

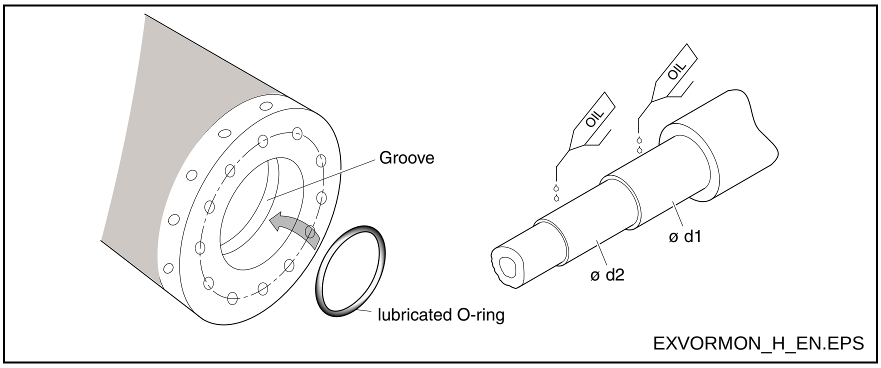


Fig. 11-9: Preparing the rotor and spindle for assembly

- Prepare the work fixture for the rotor so that the rotor is supported vertically and can take up the spindle.

Shrink-fitting the Rotor onto the Spindle

1. Heat the rotor in the heating cabinet to at least +135°C, but no more than 145°C.

Note: If the rotor is not heated to at least +135°C, it is possible for the spindle to get stuck in the rotor during the shrink-fitting process before reaching its final position.

WARNING

Burns due to hot components with temperatures above 50°C!

⇒ The rotor is hot! Contact leads to serious burn injuries!

⇒ Wear heat-resistant work clothing and heat-resistant gloves!

2. Cool the spindle to -20°C.

Note: If the spindle is not cooled to at least -20°C, it is possible for the spindle to get stuck in the rotor during the shrink-fitting process before reaching its final position.

WARNING

Injuries due to supercooled parts with temperatures down to -20°C!

⇒ The spindle is cold!

⇒ Wear suitable protective clothing and safety gloves!

3. Place the rotor into the prepared work fixture. The O-ring must be at the top.
4. Pick the spindle up and quickly slide it into the rotor.

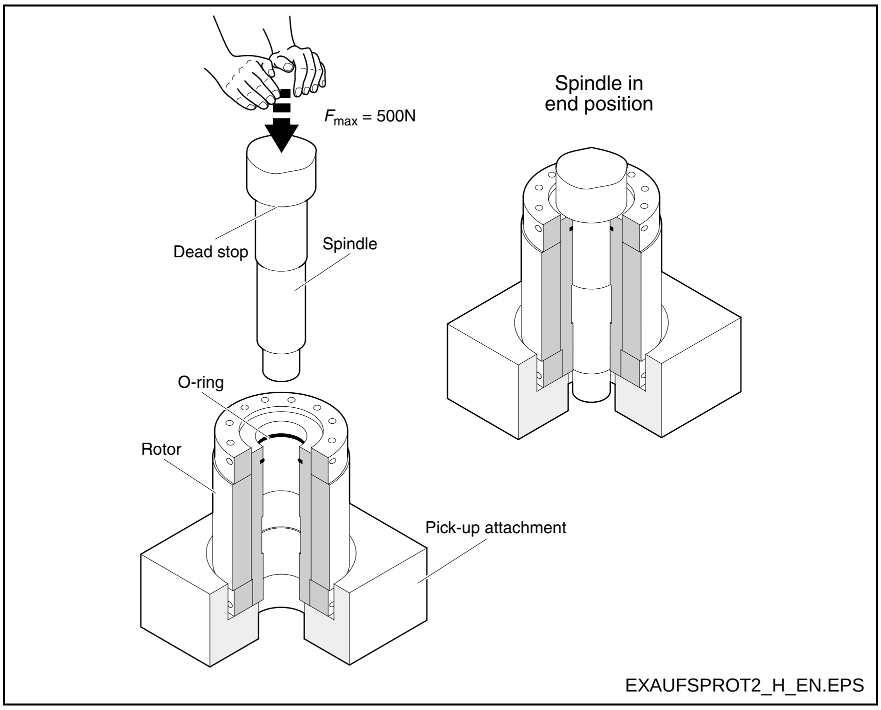


Fig. 11-10: Assembling the rotor and spindle

The spindle usually slides into its end position (final stop on spindle) without requiring additional force. If it does not slide into its end stop by virtue of its own weight, the spindle can be forced into place in the rotor with no more than 500 N (the force equal to the body weight of the mechanic).

5. Let the rotor and spindle cool to room temperature.
6. Check whether the rotor has properly shrunk onto the spindle:
   - Visually check whether the spindle is in its final position in the rotor
   - Check the concentricity of the spindle:

   Check whether the concentricity of the spindle is still as high as it was prior to shrink-fitting. If the concentricity has deteriorated, the spindle is slightly deformed. This deformation is caused by stress which can occur in the step interference fit during cooling.

Note: If the spindle is not in its final position and the necessary concentricity can not be achieved, the measures described in the “Measures to be Taken in the Case of Faulty Assembly” section (below) must be taken.

7. Use the threaded pins to close the pressure oil connections in the rotor. To do this: screw the threaded pins in all the way and secure them against rotation with LOCITE 620 (for the gluing guidelines, see section 11.3). The threaded pins must be glued into place in such a way that they completely seal the connections against oil pressure.

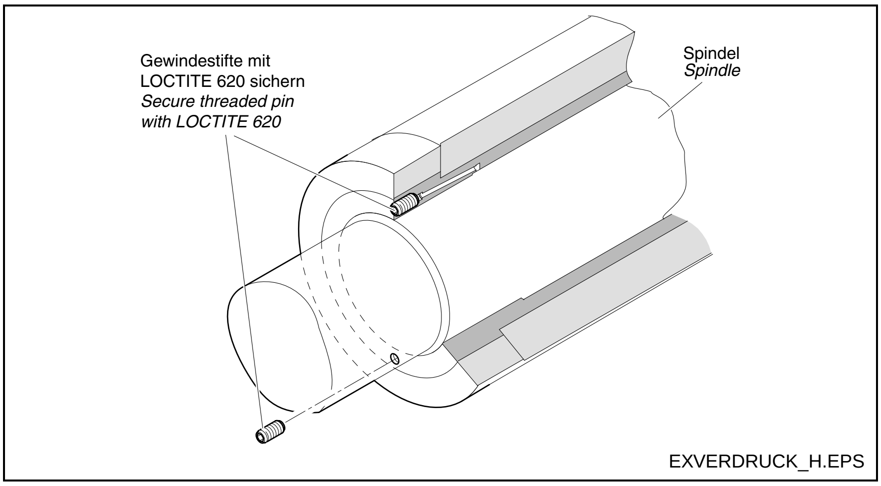


Fig. 11-11: Sealing the pressure oil connections

11.6 Measures to be Taken in the Case of Faulty Assembly

Note: The following measures apply only to a rotor with a step interference fit. Assembly mistakes for rotors with a smooth shaft cannot be corrected!

Error:

Spindle gets stuck in the rotor during the shrink-fitting process before reaching its final position.

Proceed as follows:

1. Let the rotor and spindle cool.
2. Seal one of the two pressure oil connections on the rotor with a threaded pin. This means screwing the threaded pin in all the way and securing it against turning with LOCITE 620 (for gluing guidelines, see section 11.3). The threaded pin must be glued into place in such a way that it completely seals the connection against oil pressure.
3. Force the rotor off of the spindle with the help of the pressure oil (as described below under "Removing the rotor from the spindle").
4. Check the tolerances of the press fits.
5. If necessary, remove burrs from the inside diameter of the rotor and at press fits ød1 and ød2 of the spindle.

Note: Both the spindle and the rotor must be absolutely free of burrs!

Shrink-fit the rotor onto the spindle again.

Error:

The spindle is warped after the rotor has been shrink-fitted.

Tension in the step interference fit can occur during shrink-fitting. These can cause spindle deformations in the micrometer size range. This tension and the deformations are removed by forcing oil into the step interference fit.

Proceed as follows:

1. Let the rotor and spindle cool.
2. Seal one of the two oil connections on the rotor with a threaded pin. This means screwing the threaded pin in all the way and securing it against turning with LOCITE 620 (for gluing guidelines, see section 11.3). The threaded pin must be glued into place in such a way that it completely seals the connection against oil pressure.
3. Using appropriate assembly tools, clamp the rotor and spindle to each other in such a way that the rotor is firmly held in position on the spindle.

Note: The rotor must not be permitted to shift axially on the spindle while the oil is being injected.

4. Connect the oil pump.

   Use oil with a viscosity of 300 mm^2/s at +20°C! This ensures that the oil will quickly and completely flow out after "floating".

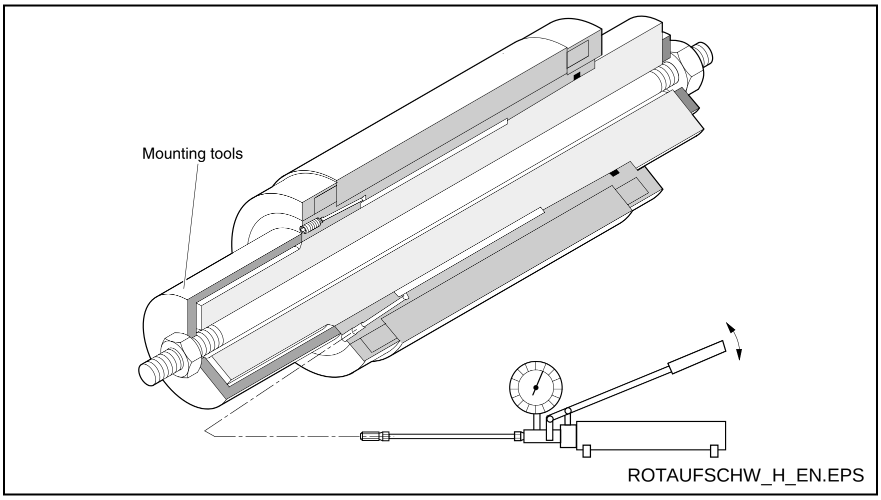


Fig. 11-12: "Floating" of the rotor

5. Pump oil into the step interference fit.

Note: Oil is exuded!

Have a collecting pan ready.

Slowly increase the oil pressure until oil begins to leak out of the coil end of the interference interface.

A separating oil film forms between the rotor and spindle. Due to this “floating“ of the rotor on the spindle, the tension that resulted from shrink-fitting is released.

6. Eliminate all pressure from the oil pump, supply lines and press group.
7. Open both oil connections.
8. Bring the spindle with the clamping device into a vertical position and, using compressed air, force the oil out of the step interference fit (see Fig.11-14).
9. Let oil completely run out of the step interference fit.

Note: The step interference fit can be placed under a full load only after 24 hours!

10. Seal both pressure oil connections with threaded pins and secure them with LOCTITE 620.

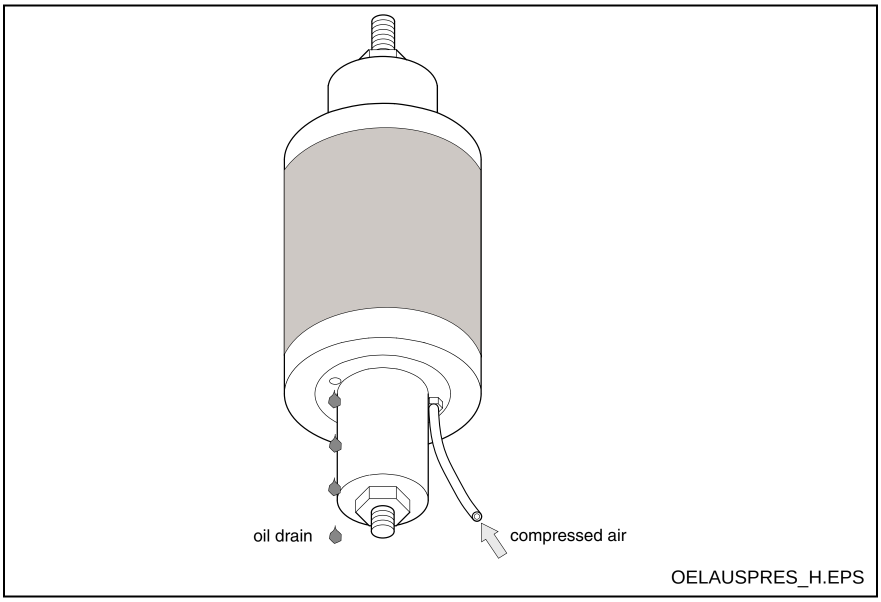


Fig. 11-13: Using compressed air to force oil out

11.7 Balancing the Rotor

The rotor must be balanced with the spindle to achieve the desired vibration severity grade of the spindle. There are balancing rings with tapped holes on the front of the rotor. Threaded pins should be screwed in as needed for balancing. Fig. 11-15 lists the threaded pins that are supplied.

The vibration severity grade needed depends on the finishing accuracy of the motor spindle; this accuracy is determined by the builder of the motor spindle.

Note: No material may be removed from the balancing rings when balancing the spindle!

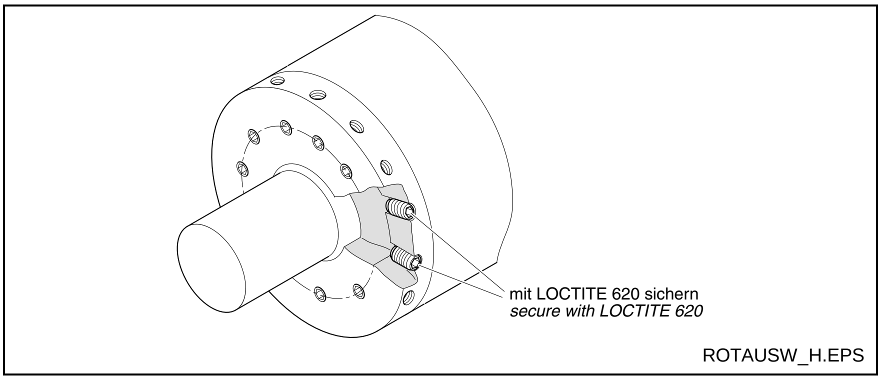


Fig. 11-14: Balancing by inserting threaded pins

Note: The threaded pins can be inserted to a greater or lesser degree, depending on the mass equilibrium required. They may not, however, protrude out of the balancing ring! It is not necessary to completely insert them!

Make sure that the threaded pins cannot become loose on their own. To do this, glue them with LOCTITE 620 - see section 11-3 for gluing guidelines. Heed the setting times with the activator! Do not use the activator if it is not necessary.

Threaded pin DIN 913	Number / MRS xx2									Weight / piece (g)
	102*	142*	162	182	202	242	272	312	382	
M6x6			8	8	8					0.76
M6x8			8	8	8					1.11
M8x8						8	8	8	10	1.89
M8x10						8	8	8	10	2.52
*) In preparation										

Fig. 11-15: Summary of the threaded pins supplied

11.8 Removing the Rotor with a Step interference fit from the Spindle

In the following cases, it may be necessary to remove the rotor from the spindle:

- damage to the bearings on the spindle
- rotor damage
- assembly mistakes

Note: The angular position of the rotor must be marked on the spindle before removal!

It is necessary to shrink-fit the rotor onto the same spindle at the position marked during re-assembly. This maintains the concentricity tolerance of the outside rotor diameter to the bearing seats.

Proceed as follows:

1. Mark the angular position of the rotor on the spindle.
2. Open a pressure oil connection.

   The second connection must remain closed. If necessary, secure it with one of the supplied threaded pins. This means screwing the threaded pin in all the way and securing it against turning with LOCITE 620 (for gluing guidelines, see section 11.3). The threaded pin must be glued into place in such a way that it completely seals the connection against oil pressure.
3. Mount the end stop (example in Fig.11-16). Note the mounting dimension (A) for the stop.

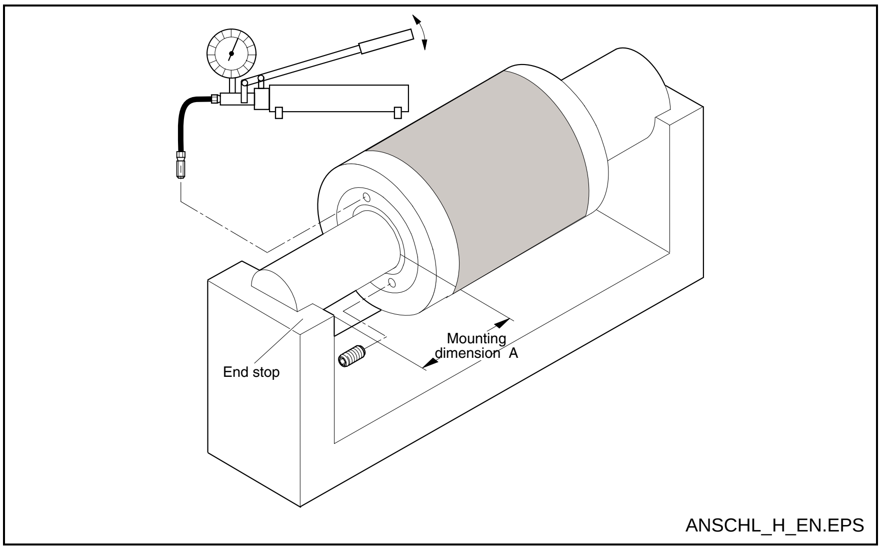


Fig. 11-16: Example for an end stop for use during removal

Rotor	Measurement A (mm)
MRS 102	i.p.
MRS 142	i.p.
MRS 162	min. 80
MRS 182	min. 90
MRS 202	min. 90
MRS 242	min. 100
MRS 272	min. 110
MRS 312	min. 130
MRS 382	min. 140

Fig. 11-17: Mounting dimension A for various rotor types

4. Connect the oil pump.
   Use oil with a viscosity of 900 mm^2/s at +20°C!

WARNING

Risk of injury from sudden rotor movements!

⇒ The rotor can suddenly slide off the spindle when oil is pumped into the step interference fit.

⇒ The spindle must be equipped with an arresting device when pumping oil in.

5. Pump oil into the step interference fit.

Note: Oil is exuded!
Have a collecting pan ready.

Slowly increase the oil pressure until the axial force affecting the step interference fit permits the rotor to slide off the spindle.

6. If oil is already leaking on the coil end of the step interference fit and the rotor still cannot be dislodged from the spindle, gently tap the rotor in the direction of the end stop with a plastic hammer.

11.9 Installing the Stator in the Spindle Housing

Stator Parts / Scope of Delivery

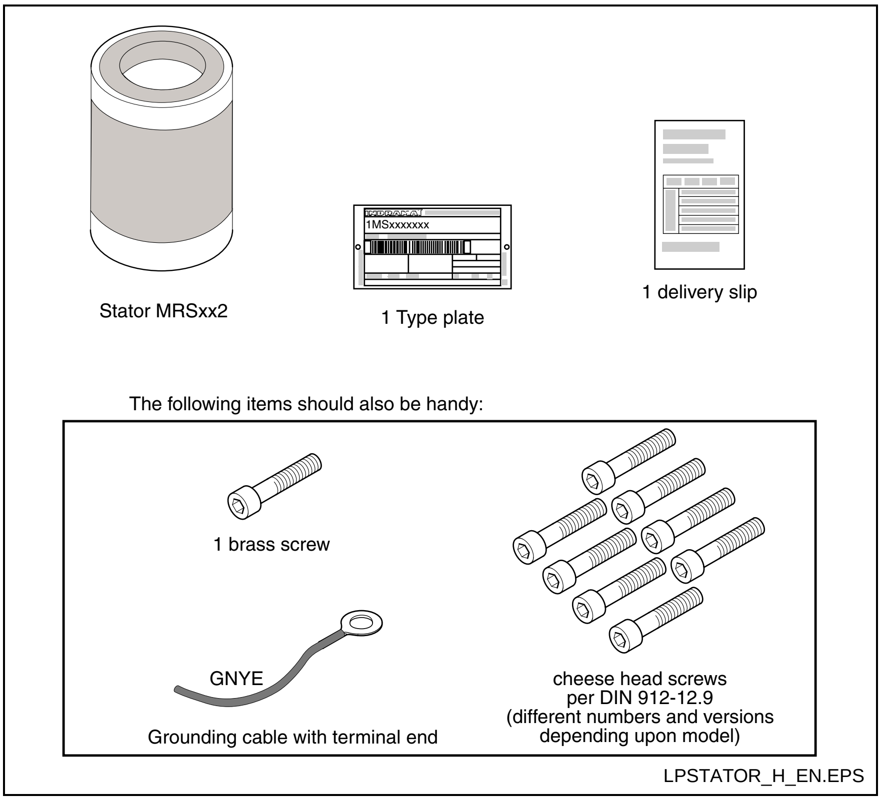


Fig. 11-18: Scope of delivery of the stator and additional materials

Before Assembly

Installation should be carried out in a dry, dust-free environment. The following preparatory measures should be taken for this purpose:

- Check to see whether all parts of the delivery are present
- Have additional materials ready. The precise dimensions of these materials are noted in the construction drawings.
- Visually check the stator for any damage.
- Mount the type plate in a conspicuous position on the spindle housing.
- Check to make sure that the drill holes for the connections on the spindle housing are free of burrs; remove these if present.

Note: The inside edges of the drill holes must be absolutely free of all burrs so as not to damage the stator during installation.

Installation Procedure

There are tapped holes on both ends of the stator for attaching the stator to the spindle housing.

Note: Attachment occurs either on the A- or the B-side of the stators, but absolutely not on both sides, since a gap between the stator and the housing is provided for the longitudinal expansion of the stator during operation.

Note: The basic procedure for attaching the stator to the housing is always the same. The procedure can vary slightly, however, from that described here, depending on the construction of the spindle housing. The following describes how the stator is mounted to the housing.

Proceed as follows:

1. Let the stator glide into the spindle housing so that it is centered. Use parallel chains or ropes to lift the stator.

Note: Do not use the cable loom as a mounting aid and do not pull or push the cable loom in any way!

The transport and handling regulations absolutely must be observed!

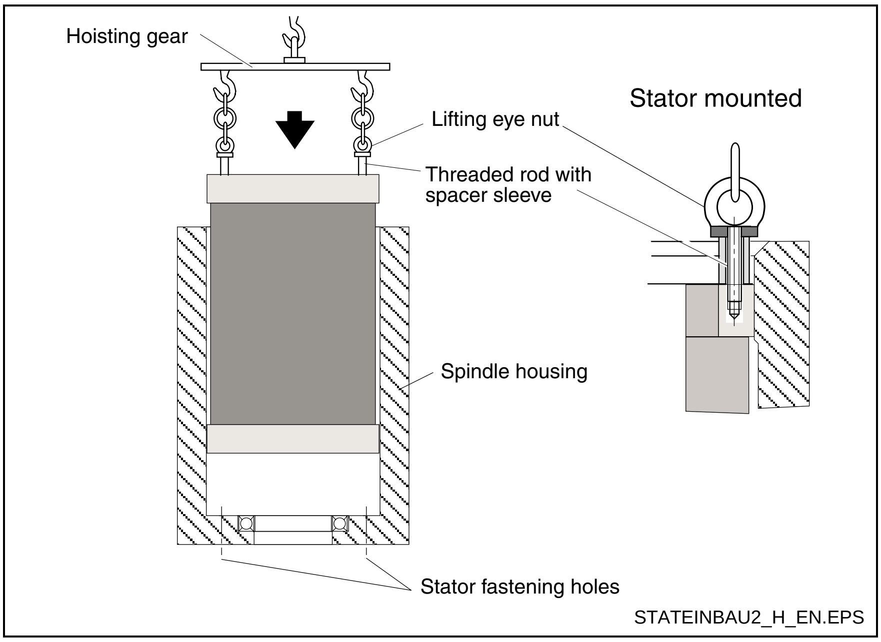


Fig. 11-19: Installing the stator into the spindle housing

2. Push the stator into its final position. Use suitable tools if assembly is difficult.
3. Screw the stator onto the end of the housing.
   - Secure the screws with LOCTITE 243; see the gluing guidelines in section 11.3.
   - Using a torque wrench, uniformly tighten the screws.

Stator	Fastening thread	Number of pieces	Tensile strength	Tightening torque
MSS102	i.p.	i.p.	12.9	i.p.
MSS142	i.p.	i.p.		i.p.
MSS162	M6 x 12	6		14 – 16 Nm
MSS182	M6 x 12	6		14 – 16 Nm
MSS202	M6 x 12	10		14 – 16 Nm
MSS242	M8 x 15	12		34 – 38 Nm
MSS272	M8 x 16	14		34 – 38 Nm
MSS312	M8 x 20	14		34 – 38 Nm
MSS382	M8 x 20	18		34 – 38 Nm

Fig. 11-20: Fastening screws for stator

Connecting the Stator

You can find notes regarding the electrical and cooling connections of the stator in chapter 8 "Connection Techniques" of this documentation.

11.10 Removing the Stator from the Spindle Housing

The stator may have to be removed if, for example:

- a winding has burned out or
- the PTC resistors are defective.

DANGER

Electrocution due to live parts!

⇒ Before removing the stator, you absolutely must switch the power for the electrical system off and ensure that it cannot be accidentally switched on again!

Proceed as follows:

1. Detach the electrical connections:
   - Power connector
   - PTC resistor connection
   - Grounding cable
2. Loosen the cooling connections.
3. Loosen and remove the stator fastening screws.
4. Using appropriate tools, slowly pull out the end plate.
5. Screw transportation rings into the appropriate holes.

Note: Avoid pulling or pushing the cable loom during removal to avoid damaging the stator!

The transport and handling regulations absolutely must be observed!

6. Using appropriate lifting equipment, slowly pull out the stator (caution: the stator is heavy!).

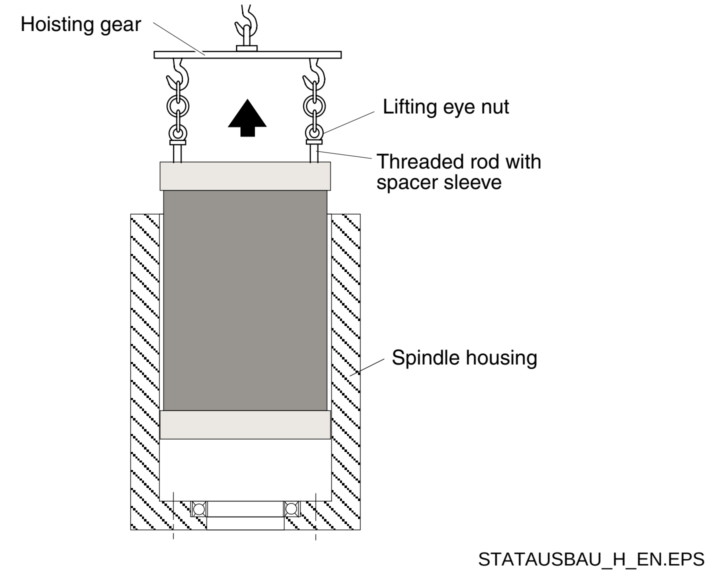


Fig. 11-21: Removing the stator from the spindle housing

11.11 Mounting the Motor Spindle

After the rotor has been mounted on the spindle and the stator has been installed in the spindle housing, the parts can be assembled into a complete motor spindle.

Note: The pre-assembled rotor package must be inserted centrally into the prepared stator package.

- Ensure that assembly equipment is on hand so that the rotor package can be inserted centrally into the stator.

CAUTION

Material damage and/or injuries due to transport procedures!

⇒ Heed all required notes regarding safety when working with transport and load handling equipment.

⇒ Carefully move the spindle with the rotor towards the stator. Danger of squeezing!

Proceed as follows:

1. Ensure that both components are free of dirt.
2. Using suitable lifting equipment, move the rotor package over the center of the stator package.
3. Slowly lower the rotor package over the stator package and let it move into the stator package.

Note:	Avoid contact with or damage to the surfaces of the interiors of the rotor and stator during insertion.

4. Attach the end plate to the spindle housing.

WARNING

Injuries/damage due to strong magnetic field

⇒ Carefully move the rotor package towards the stator. Danger of squeezing!

⇒ Due to the permanent magnets on the rotor and the resulting magnetic forces, the rotor is attracted to the stator.

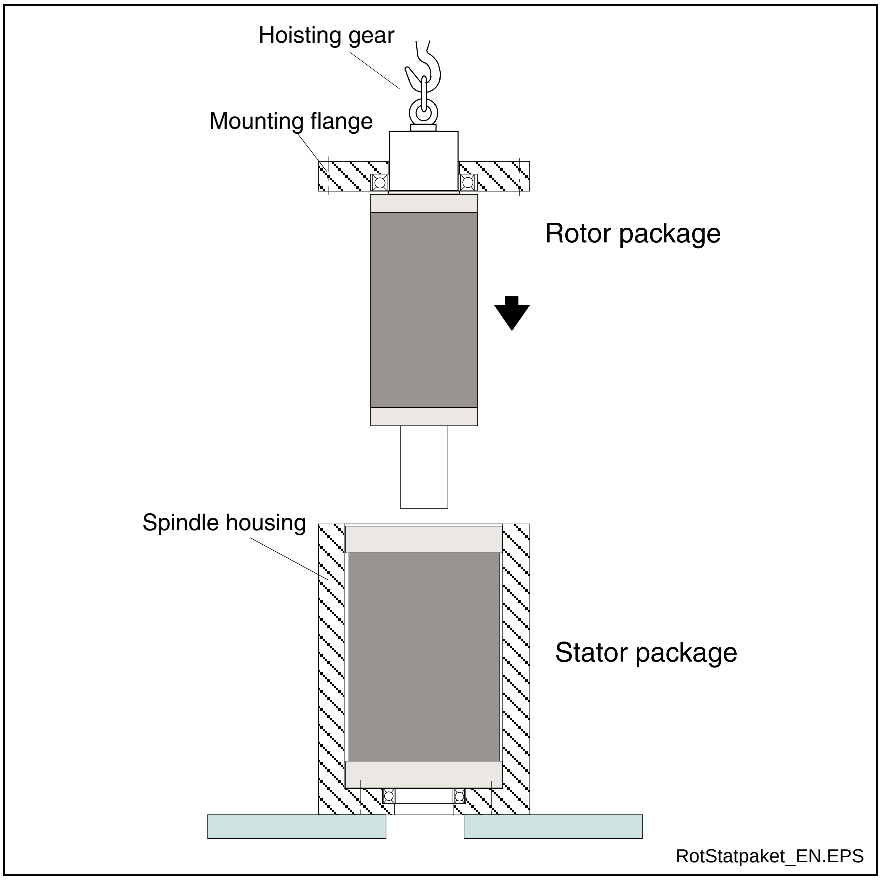


Fig. 11-22: Motor spindle assembly

Pay attention to the resulting radial and axial forces when inserting the rotor.

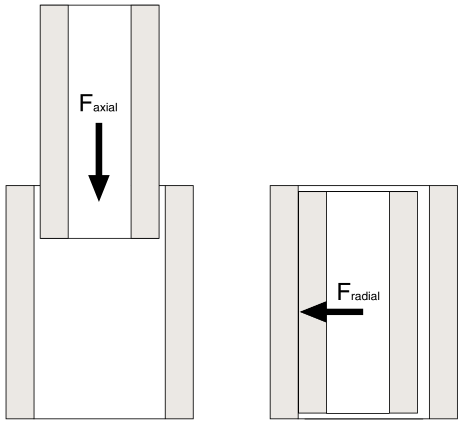


Fig. 11-23: Forces of attraction during assembly

Motor frame size		F_{axial} [N]	F_{radial} [N]
102	B	186	295
	D		444
	F		740
142	B	265	635
	D		890
	F		1140
162	B	310	960
	D		1214
	F		1518
	J		1973
182	A	360	214
	B		1498
	D		1890
	J		2730
202	A	420	1658
	B		2206
	D		2758
	F		3860
242	B	480	3050
	D		4576
	F		5490
272	B	570	5290
	D		6880
	F		8470
312	B	690	9180
	D		11480
	F		13780
382	F	870	27280

Fig. 11-24: Magnetic forces of attraction

11.12 Dismantling the Motor Spindle

Dismantling of the motor spindle occurs in inverse order of assembly.

Proceed as follows:

1. Loosen and remove the fastening screw between the end plate and the spindle housing.
2. Using suitable lifting equipment, pull the rotor package out of the center of the stator package.

Note: Avoid contact with or damage to the surfaces of the interiors of the rotor and stator during removal.

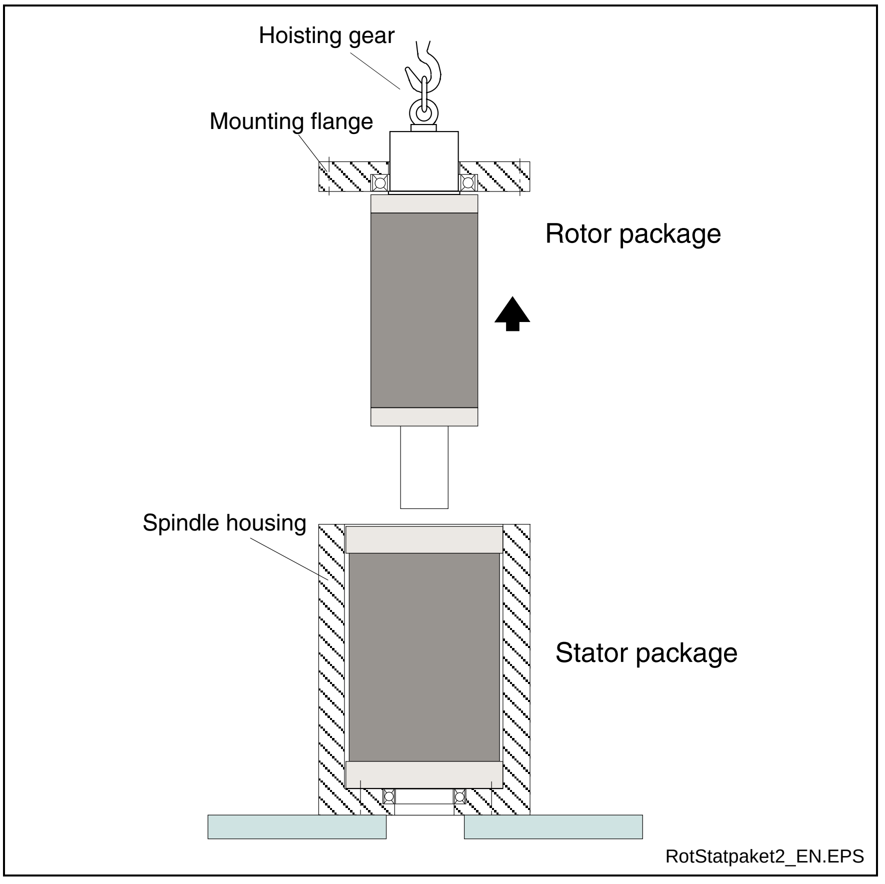


Fig. 11-25: Dismantling the motor spindle

12 Startup, Operation and Maintenance

12.1 General Information on Startup IndraDyn H Motors

The following points must be heeded especially when starting up IndraDyn H frameless synchronous motors.

Parameters

IndraDyn H motors are frameless motors whose individual components – supplemented by an encoder system – are directly installed into the machine by the manufacturer. As a result, frameless motors have no data memory to supply motor parameters, standard controller settings, etc. During startup, all parameters must be manually entered or loaded into the drive. The startup program DriveTop provides all Bosch Rexroth motor parameters.

Encoder polarity

If you view the A-side (opposite the cable outlet), the encoder must indicate a positive command value if the rotor is turning clockwise. This connection must be established before commutation adjustment.

Commutation adjustment

For IndraDyn H motors, it is generally necessary to receive the position of the rotor compared to the stator immediately after startup or after a malfunction. This is called identification of pole position or commutation adjustment. The commutation adjustment process is therefore the establishment of a position reference to the electrical or magnetic model of the motor. The commutation adjustment method depends on the encoder type used.

Other applicable documents

In addition to the motor documents listed here, you need further documents to commission the motors, such as:

- Rexroth IndraDrive Firmware for Drive Control Devices - Functional Description, MNR R911299225
- Rexroth IndraDrive Drive Control Devices - Parameter Description, MNR R911297317
- Rexroth IndraDrive Notes Regarding Error Elimination, MNR R911297319

12.2 Basic Requirements

The following preconditions must be fulfilled for successful startup.

- Compliance to the safety instructions and notes.
- Check of electrical and mechanical components for safe functioning.
- Availability and supply of required materials.
- Adherence to the startup procedure described below.

Check of all Electrical and Mechanical Components

Carry out a check of all electrical and mechanical components before starting startup. Heed the following points in particular:

- Safety of personnel and machine
- Proper installation of the motor.
- Correct power connection of the motor.
- Correct connection of the encoder.
- Functioning of available safety limit switches, door switches, etc.
- Proper functioning of the emergency stop circuit.
- Machine construction / mechanical installation in proper and complete condition.
- Correct connection and functioning of the motor cooling system.
- Proper connection and functioning of the drive controller unit.

WARNING

Danger to life, severe injury or material damage due to errors or malfunctions on mechanical or electrical components!

⇒ Troubleshoot mechanical and electrical components before continuing startup.

WARNING

Risk of injury or danger to life, as well as damage due to non-adherence of warning and safety notes!

⇒ Adherence of the warning and safety notes.

⇒?Startup must to be executed by skilled personnel.

⇒ Adherence to the startup procedure described below.

Materials

DriveTop startup software

Startup can be executed directly via an NC terminal or using special startup software. The DriveTop startup software makes menu-driven, custom-designed and motor-specific parameterization and optimization possible.

PC

A normal Windows PC is required for startup with DriveTop.

Startup via NC

For startup using the NC control, access to all drive parameters and functions must be ensured.

Oscilloscope

An oscilloscope is needed for drive optimization. It is used to display the signals, which can be shown via the adjustable analog output of the drive controller. Signals that can be displayed include the command and actual values of the speed, position or voltage, position lag, intermediate circuit performance, etc.

Multimeter

A multimeter with the possibility of measuring voltages and resistances can be helpful for troubleshooting and checking the components .

12.3 General Startup Procedure

The following flow chart shows the general startup procedure for IndraDyn H frameless synchronous motors. In the following sections, these points are explained in detail.

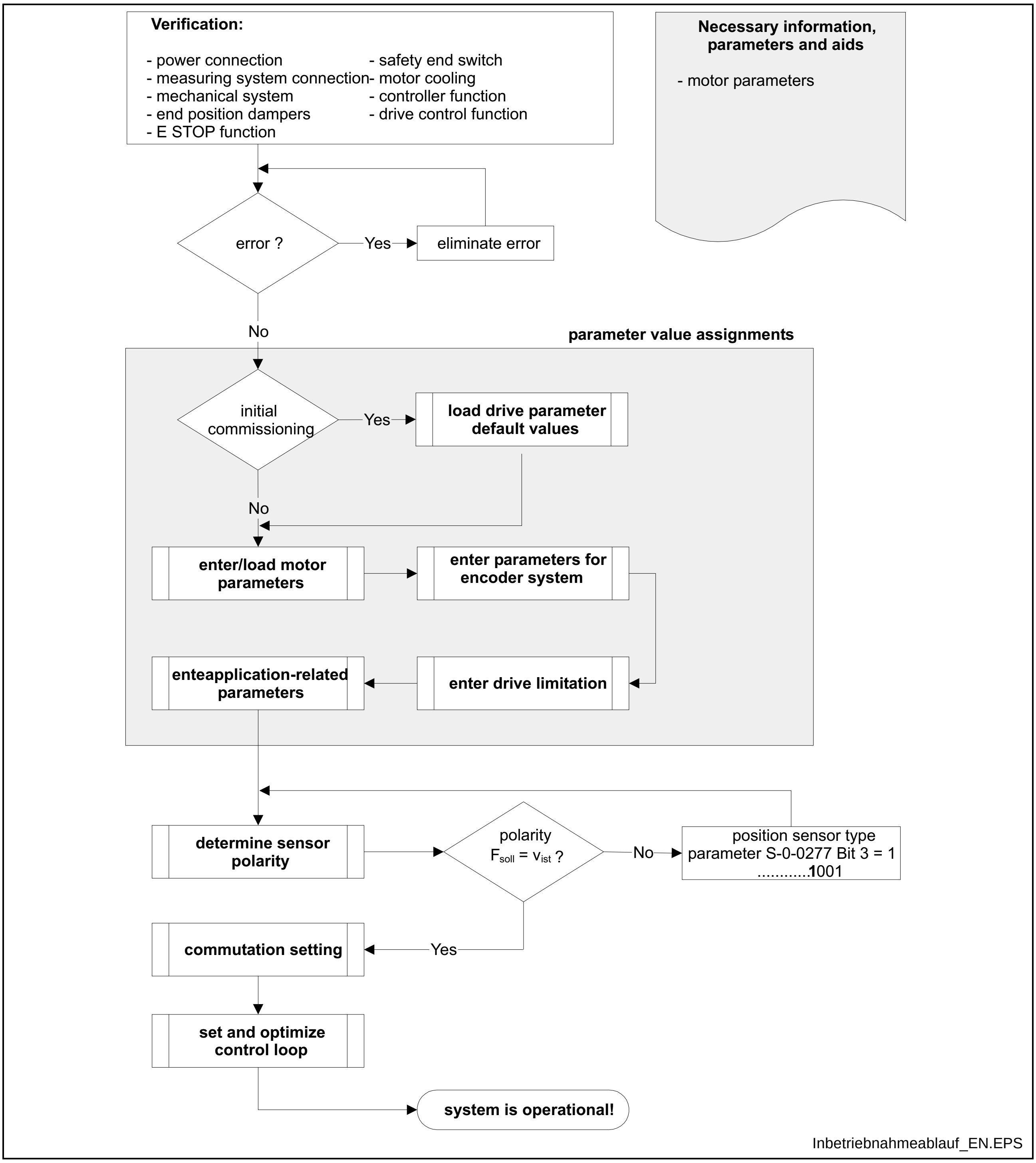


Fig. 12-1: General startup procedure for frameless synchronous motors

12.4 Parametrization

With DriveTop, entering or editing certain parameters and executing commands during the startup process is done using menu-guided dialog boxes or in list representations; optionally, it can also be performed via the control terminal.

Entering Motor Parameters

Note: The motor parameters are specified by Rexroth and must not be changed by the user. Startup is not possible if these parameters are not available. In this case, please contact your Rexroth sales and service facilities.

WARNING

Injuries and mechanical damage if the motor is switched on immediately after the motor parameters have been entered! Entering the motor parameters does not make the motor operational!

⇒ Do not switch on the motor immediately after the motor parameters have been entered.

⇒ Enter the parameters for the encoder system.

⇒ Check and adjust the encoder polarity.

⇒ Perform commutation adjustment.

The motor parameters should be entered in the following way:

- Use DriveTop to load all the motor parameters.

If the DriveTop startup software is not available:

- Enter the individual parameters manually via the controller. You can obtain a list of the corresponding motor parameters from your local sales center.

Motor parameters

Sercos ID	Motor parameter
P-0-0004	Velocity loop smoothing time constant
P-0-0018	Number of pole pairs/pole pair distance
P-0-0045	Control word of current control
P-0-0051	Torque/force constant
P-0-0512	Temperature sensor
P-0-0533	Voltage loop proportional gain
P-0-0534	Voltage loop integral action time
P-0-0535	Motor voltage at no load

P-0-0536	Maximum motor voltage
P-0-4002	Characteristic of quadrature-axis induct. of motor, inductance
P-0-4003	Characteristic of quadrature-axis induct. of motor, currents
P-0-4005	Flow-generating current, limit value
P-0-4014	Type of construction of motor
P-0-4016	Direct-axis inductance of motor
P-0-4017	Quadrature-axis inductance of motor
P-0-4034	Thermal time constant of winding
P-0-4035	Thermal time constant of motor
P-0-4036	Rated motor speed
P-0-4037	Thermal short-time overload of winding
P-0-4048	Stator resistance
S-0-0100	Velocity loop proportional gain
S-0-0101	Velocity loop integral action time
S-0-0106	Current loop proportional gain 1
S-0-0107	Current loop integral action time 1
S-0-0109	Motor peak current
S-0-0111	Motor current at standstill
S-0-0113	Maximum motor speed
S-0-0201	Motor warning temperature
S-0-0204	Motor shutdown temperature

Fig. 12-2: IndraDyn H motor parameters

Entering Encoder System Parameters

Encoder type

The encoder system type must be defined. Parameter P-0-0074, Encoder type 1 is used for this (see also Fig. 9-83).

Encoder type	P-0-0074
Incremental encoder, e.g. Lenord & Bauer gear encoder	2
Absolute encoder, e.g. Rexroth DSF or Rexroth HSF encoder	1

Fig. 12-3: Encoder type definition

Signal period

Encoder systems for IndraDyn H motors generate and evaluate **sinusoid signals**. The sine signal period must be entered in parameter S-0-0116, Encoder 1 resolution.

The required information is provided by the encoder manufacturer.

Entering Drive Limitations and Application-Dependent Parameters

Drive limitations

The drive limitations that can be set include:

- Current limitation
- Torque limitation
- Speed limitation
- Travel range limits

Application-related parameters

The application-related drive parameters include, for example, the parameters of the drive fault reaction.

Note: Detailed information is provided in the IndraDrive functional description, MNR R911299225.

12.5 Determining the Polarity of the Encoder System

In order to avoid direct feedback in the velocity control circuit, the effective direction of the motor torque and the counting direction of the encoder system must be the same.

WARNING

Different effective directions of the motor torque and the counting direction of the encoder system cause uncontrolled movements of the motor upon power-up!

⇒ Take measures against uncontrolled movement.

⇒ Set the effective direction of the motor torque so that it is the same as the counting direction of the encoder system.

Before checking the encoder polarity, ensure that the following parameters are set according to Fig. 12-4.

ID number	Description	Value
S-0-0085	Torque/force polarity parameter	0000000000000000
S-0-0043	Velocity polarity parameter	0000000000000000
S-0-0055	Position polarity	0000000000000000

Fig. 12-4: Table of polarity parameters

The encoder polarity is selected via parameter

S-0-0277, Position encoder type 1 (Bit 3)

The position, velocity and force data must not be inverted when the encoder system counting direction is set:

S-0-0085, Force polarity parameter:	0000000000000000
S-0-0043, Velocity polarity parameter:	0000000000000000
S-0-0055, Position polarities:	0000000000000000

Note: After the polarity of the encoder has been set, it must be ascertained that the encoder supplies positive signals when the motor turns clockwise or that it supplies negative signals when the motor turns counterclockwise.

12.6 Commutation Adjustment

DANGER

Malfunction due to errors in activating motors and moving elements!
Commutation adjustment must always be performed in the following cases:

⇒ Startup

⇒ Modification of the mechanical attachment of the encoder system

⇒ Replacement of the encoder system

⇒ Modification of the mechanical attachment of the stator and/or rotor

WARNING

Malfunction and/or uncontrolled motor movement due to error in commutation adjustment!

⇒ Effective direction of the motor torque = counting direction of the encoder system

⇒ Adhere to the described setting procedures

⇒ Correct motor and encoder parameterization

⇒ Expedient parameter values must be assigned to the current and velocity control circuit

⇒ Correct connection of the motor power cable

⇒ Protection against uncontrolled movements

Setting the correct commutation angle is a prerequisite for maximum and constant torque development of the frameless synchronous motor.

This procedure ensures that the angle between the current vector of the stator and the flux vector of the rotor is always 90°. The motor supplies the maximum torque in this state.

Motor connection

The individual phases of the motor power connection must be assigned correctly. See also chapter 8, “Connection Techniques”.

Adjustment procedure

Different commutation adjustment procedures have been implemented in the firmware. Parameter P-0-0522 is used to make the selection. The following figure provides an overview of the relationship between the encoder system that is used and the procedure to be implemented.

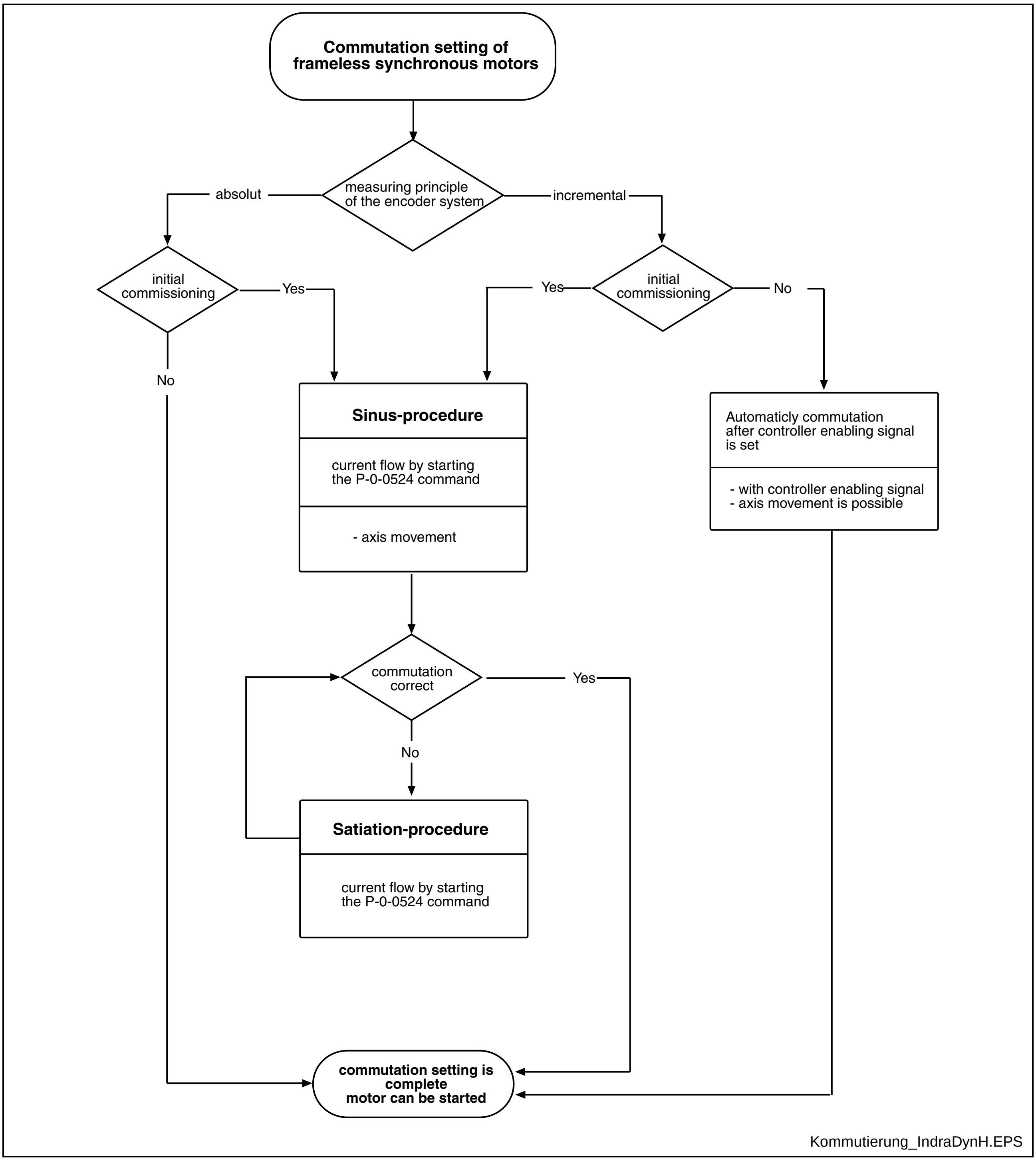


Fig. 12-5: Commutation adjustment method for frameless synchronous motors

Note: A detailed description of the individual procedures is provided in the firmware description for Rexroth IndraDrive control devices, MNR R911299225.

12.7 Setting and Optimizing the Control Circuit

General Procedure

The control circuit settings in a digital drive controller are significant for the characteristics of the servo axis. The control circuit structure consists of a cascaded position, velocity and current controller. The corresponding mode defines the active controllers.

Note: Defining the control circuit settings requires the corresponding expertise.

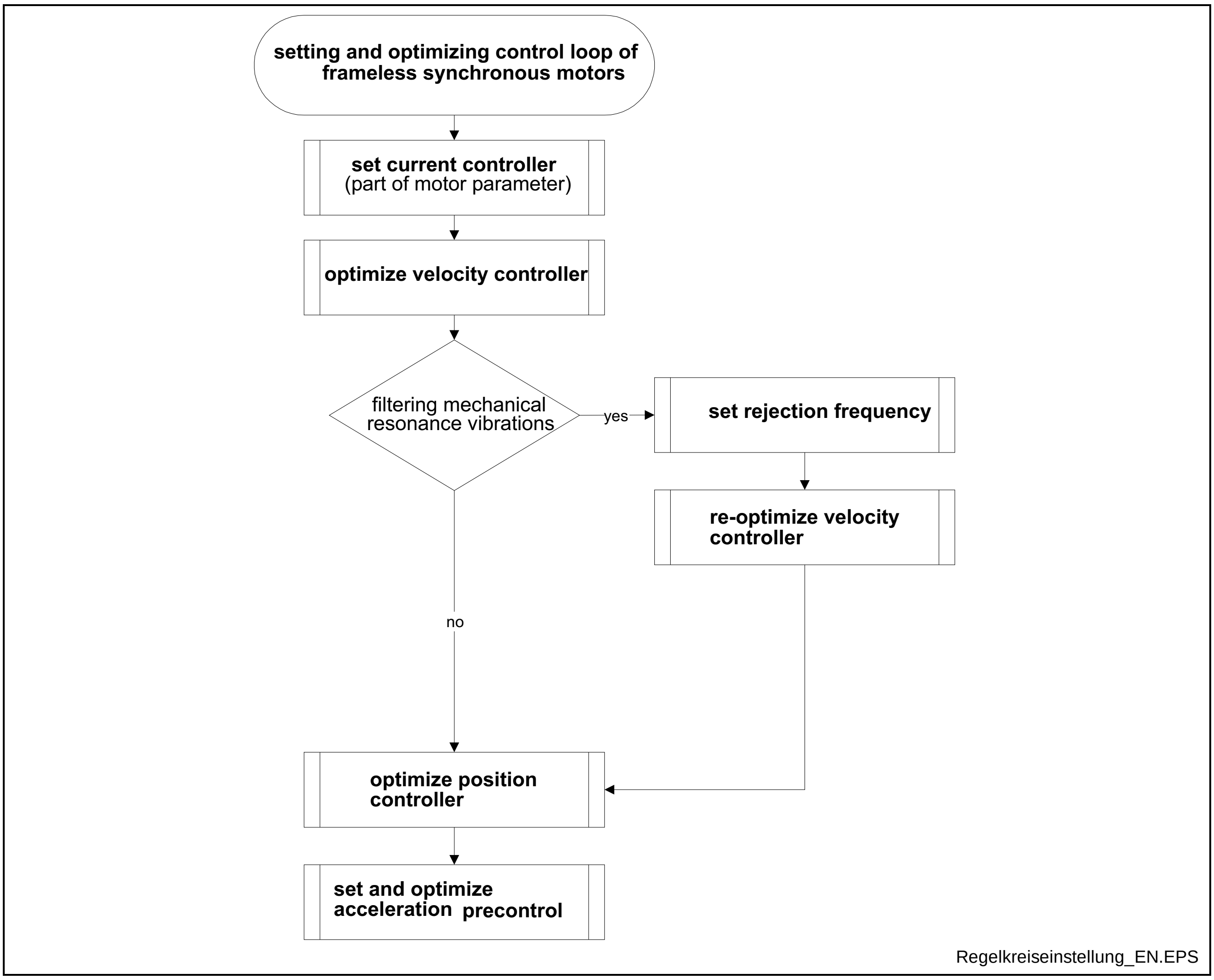


Fig. 12-6: Setting and optimizing the control circuit of frameless synchronous motors

Note: Use the functional description of the drive controller for more detailed information

Filtering mechanical resonance oscillations

Rexroth digital drives are able to provide narrow-band suppression of oscillations that are produced due to the power train between the motor and mechanical axis system. This results in increased drive dynamic with good stability.

The position or velocity feedback in the closed control circuit excites the mechanical system of the slide that is moved by the motor to perform mechanical oscillations. This behavior, known as “two-mass oscillation”, is mainly in the frequency range between 400 and 800 Hz. It depends on the rigidity of the mechanical system and the spatial expansion of the system.

In most cases, this “two-mass oscillation” has a clear resonant frequency that can selectively be suppressed by a rejection filter in the drive.

When the mechanical resonant frequency is suppressed, improving the dynamic properties of the velocity control circuit and of the position control circuit compared with control without the stop filter may be possible.

This leads to an increased profile accuracy and to smaller cycle times for positioning processes at a sufficient distance to the stability limit.

The stop frequency and bandwidth of the filter can be selected. The highest attenuation takes effect on the stop frequency. The bandwidth defines the frequency range at which the attenuation is less than -3 dB. A higher bandwidth leads to less attenuation of the stop frequency!

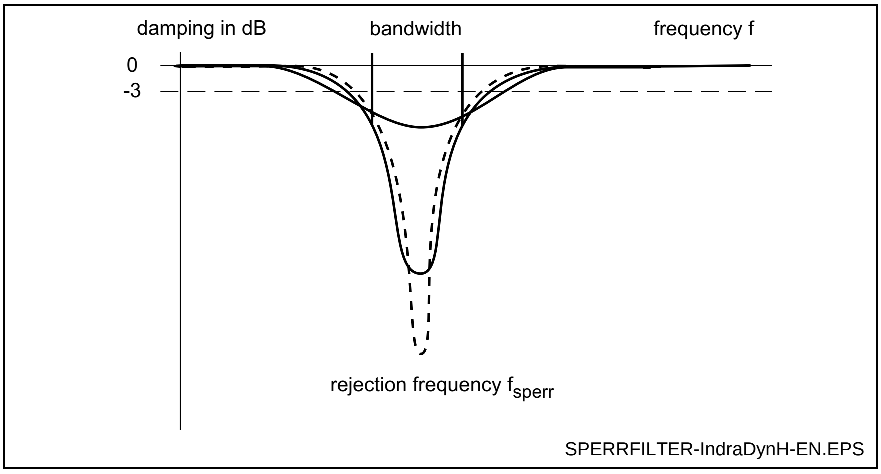


Fig. 12-7: Amplitude frequency curve stop filter vs. bandwidth, qualitative

12.8 Maintenance and Inspection of Motor components

IndraDyn H motor components do not require maintenance. However, due to external influences, the motor components can be damaged during operation. Preventive maintenance should occur within the service intervals of the machine/system.

Check of Motor and Auxiliary Components

The following points, among others, should be observed during the preventive check of motor and auxiliary components:

- Seal of liquid cooling, hoses and connections
- Condition of power can encoder cables

Electrical Check of Motor Components

An electrical defect of a stator can be checked by measuring electrical characteristics. The following variables are relevant:

- Resistance between motor connecting wires 1-2, 2-3 and 1-3
- Inductance between motor connecting wires 1-2, 2-3 and 1-3
- Insulation resistance between motor connecting wires and guides

Resistance and inductance

The measured values of the resistance and inductance can be compared with the values specified in chapter 4, “Technical Data”. The individual values of the resistance and inductance measured between connections 1-2, 2-3 and 1-3 should be identical within a specific tolerance. There can be a phase short-circuit, a fault between windings, or a short-circuit to ground if one or more values differ significantly.

Note: If the measured values differ to a great degree, consult the Bosch Rexroth customer service department.

Insulation resistance

The insulation resistance – measured between the motor connecting wires and ground – should be at least 1 MΩ.

Note: If the resistance is too low, consult the Bosch Rexroth customer service department.

12.9 Startup

CAUTION

Material damage due to errors in activating motors and moving elements! Unclear operating states and product data!

⇒ Do not carry out startup if connections, operating states or product data are unclear or faulty!

⇒ Do not carry out startup if the safety and monitoring equipment of the system is damaged or not in operation.

⇒ Damaged products may not be operated!

⇒ Contact Rexroth for missing information or support during startup!

Note: Commutate IndraDyn H motors according to section 12.6 “Commutation Adjustment” and the function description of the firmware used in the drive controller.

The following startup notes refer to the motors as part of a drive system with drive and control devices.

Preparation

1. Keep the documentation of all used products at hand.
2. Log all measures taken in the startup log.
3. Check the products for damage.
4. Check all mechanical and electrical connections.
5. When setting up and programming the machine, pay attention to the motor and encoder rotation directions.
6. Activate the safety and monitoring equipment of the system.

Execution

When all prerequisites have been fulfilled, proceed as follows:

1. Activate the cooling system to supply the motor and check for proper operation. Heed the notes of the manufacturer.
2. Carry out the startup of the drive system according to the instructions of the respective documentation. You can find the respective information in the functional description of the drive control devices.
3. Log all measures taken in the startup report.

Startup of drive controllers and control systems may require additional steps. The inspection of the functioning and performance of the systems is not part of startup the motor; instead, it is carried out within the framework of startup the entire machine. Observe the information and regulations of the machine manufacturer.

12.10 Deactivation

In the case of malfunctions, maintenance measures or to deactivate the motors, proceed as follows:

1. Observe the instructions of the machine documentation.
2. Use the machine-side control commands to bring the drive to a controlled standstill.
3. Switch off the power and control voltage of the drive controller.
4. Switch off the master switch of the machine and deactivate external systems according to the instructions of the manufacturer.
5. Secure the machine against accidental movements and against unauthorized operation.
6. Wait for the discharge time of the electrical systems to expire and disconnect all electrical connections if necessary. Protect all electrical cables and contacts against contact with other electric conducting parts.
7. Document all executed measures in the startup report and the machine maintenance plan.

12.11 Dismantling

DANGER

Fatal injury due to errors in activating motors and moving elements!

⇒ Do not work on unsecured and operating machines.

⇒ Secure the machine against accidental movements and against unauthorized operation.

⇒ Before dismantling, secure the motor and feeder against falling or movements before disconnecting the mechanical connections.

⇒ Pay attention to the strong magnetic field surrounding the rotor.

1. Observe the instructions of the machine documentation and the dismantling instructions.
2. Heed the safety notes and carry out all steps as described in the instructions in the chapter "Deactivation" (above).
3. Before dismantling, secure the motor and feeder against falling or movements before disconnecting the mechanical connections.
4. Empty the coolant duct of the motor and dismantle the motor from the machine. Store the motor properly!
5. Document all executed measures in the startup report and the machine maintenance plan.

12.12 Maintenance

Synchronous motors of the IndraDyn H series operate without maintenance within the given operating conditions and service life. However, operation under unfavorable conditions can lead to limitations in availability.

⇒ Increase availability with regular preventive maintenance measures. Heed the information in the maintenance schedule of the machine manufacturer and the service measures described below.

⇒ Log all maintenance measures in the machine maintenance plan.

Measures

DANGER

Danger of injury due to moving elements!
Danger of injury due to hot surfaces!

⇒ Do not carry out any maintenance measures when the machine is running.

⇒ During maintenance work, secure the system against restarting and unauthorized use.

⇒ Do not work on hot surfaces.

Bosch Rexroth recommends the following maintenance measures, based on the maintenance plan of the machine manufacturer:

Measure	Interval
Check the function of the coolant system	According to the guidelines in the machine maintenance plan, but at least every 1000 operating hours.
Check the mechanical and electrical connections.	According to the guidelines in the machine maintenance plan, but at least every 1000 operating hours.
Check the machine for smooth running, vibrations and bearing noises.	According to the guidelines in the machine maintenance plan, but at least every 1000 operating hours.
Remove dust, chips and other dirt from the motor housing, cooling fins and the connections.	Depending on the degree of soiling, but after one operating year at the latest.

Fig. 12-8: IndraDyn H maintenance measures

Coolant Supply

It may become necessary to dismantle the coolant supply for maintenance measures or troubleshooting.

⇒ This work must be carried out only by qualified personnel.

⇒ Do not carry out any maintenance measures if the machine is running or if the coolant lines are under pressure. Please observe the safety instructions.

⇒ Protect open supply cables and connections against penetration of pollution.

12.13 Troubleshooting

DANGER

Danger of injury due to moving elements!
Danger of injury due to hot surfaces!

⇒ Do not carry out any maintenance measures when the machine is running.

⇒ Switch off the control device and the machine and wait for the electrical systems to discharge.

⇒ During maintenance work, secure the system against restarting and unauthorized use.

⇒ Do not work on hot surfaces.

Possible causes for the malfunctioning of IndraDyn H motors can be limited to the following areas:

- Motor-cooling circuit and temperature trend
- Internal temperature sensor
- Mechanical damage of the motor
- Mechanical connection to machine

The encoder and temperature sensor are controlled by the drive controller or control unit and are displayed according to the diagnosis. Observe the notes in the corresponding documentation.

Some error states with potential causes are shown as examples below. This list does not lay claim to completeness.

Excess temperature of motor housing

Status The housing temperature of the motor climbs to unusually high values.

CAUTION

Damage of motor or machine by restarting after excess motor temperature!

⇒ Liquid-cooled motors should not be restarted immediately or with cold coolant after failure of the coolant system. Danger of damage!

⇒ Before restarting, wait until the motor temperature drops to approx. 40°C.

Possible causes

1. Failure in the coolant system.
2. Original processing cycle has been changed.
3. Original motor parameters have been changed.
4. Motor bearings worn or defective.

Corrective measures

1. Check the coolant system. Clean or rinse the cooling circuit if required. Contact the machine manufacturer if the coolant system fails.
2. Check the layout of the drive for changed requirements. If overloading occurs, stop operation. Danger of damage!
3. Reset to the original parameters. Check the layout of the drive in the case of changed requirements.
4. Contact the machine manufacturer.

High motor temperature values, but housing temperature is normal

Status The diagnostics system of the drive controller shows unusually high values for the winding temperature via the display or control software. However, the motor housing has a normal temperature.

Possible causes

1. Wiring error or cable break in sensor cable.
2. Diagnostics system defective.
3. Winding temperature sensor failure (PTC).

Corrective measures

1. Check the wiring and connection of the temperature sensor according to the connection plan.
2. Check the diagnostics system on the device controller or the control.
3. Check the resistance value of the temperature sensor using a multimeter.
   - Switch off the system and await the discharging time.
   - Sever the connection of the temperature sensor on the control device. Set the measuring instrument to resistance measurement and connect the core pair with the measuring instrument (the sensor cable is also checked in this case). Check the values according to the characteristic curve in chapter 9 ”Application Notes”.

Motor or machine generates vibrations

Status

Audible or tactile vibrations occur on the motor or on the machine.

Possible causes

1. Driven machine elements are insufficiently coupled or damaged.
2. Motor bearings worn or defective. Available bearing lifetime or grease lifetime elapsed.
3. Motor mount loose.
4. Drive system control circuit is instable from a control point of view.

Corrective measures

1. Contact the machine manufacturer.
2. Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
3. Check the parameters of the drive system (motor and encoder data). Observe the troubleshooting notes in the documentation for the drive controller.

Specified position is not attained

Status

The positioning command of the control is not precisely executed – or not at all. No malfunction display on the drive controller or the control.

Possible causes

1. Wiring of encoder cable is incorrect or defective. Pin assignment (encoder signals) in cable or plug may be switched.
2. Insufficient shielding of encoder cable against interference.
3. Incorrect encoder parameters set in drive controller.
4. Motor-machine connection loose.
5. Encoder defective.

Corrective measures

1. Check the wiring according to the connection plan and check the state of cables for damage.
2. Check the shielding; if necessary, increase the effective contact surfaces of the shielding.
3. Correct the parameters. Observe the start-up report for original values.
4. Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
5. Change of encoder necessary. Contact the machine manufacturer.

13 Service & Support

13.1 Helpdesk

Unser Kundendienst-Helpdesk im Hauptwerk Lohr am Main steht Ihnen mit Rat und Tat zur Seite. Sie erreichen uns

Our service helpdesk at our headquarters in Lohr am Main, Germany can assist you in all kinds of inquiries. Contact us

- telefonisch - by phone: **+49 (0) 9352 40 50 60**
  über Service Call Entry Center Mo-Fr 07:00-18:00
  - via Service Call Entry Center Mo-Fr 7:00 am - 6:00 pm
- per Fax - by fax: **+49 (0) 9352 40 49 41**
- per e-Mail - by e-mail: **service.svc@boschrexroth.de**

13.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

After helpdesk hours, contact our service department directly at

+49 (0) 171 333 88 26

oder - or **+49 (0) 172 660 04 06**

13.3 Internet

Unter **www.boschrexroth.com** finden Sie ergänzende Hinweise zu Service, Reparatur und Training sowie die **aktuellen** Adressen *) unserer auf den folgenden Seiten aufgeführten Vertriebs- und Servicebüros.

☐ Verkaufsniederlassungen
☐ Niederlassungen mit Kundendienst

Außerhalb Deutschlands nehmen Sie bitte zuerst Kontakt mit unserem für Sie nächstgelegenen Ansprechpartner auf.

*) Die Angaben in der vorliegenden Dokumentation können seit Drucklegung überholt sein.

At **www.boschrexroth.com** you may find additional notes about service, repairs and training in the Internet, as well as the **actual** addresses *) of our sales- and service facilities figuring on the following pages.

☐ sales agencies
☐ offices providing service

Please contact our sales / service office in your area first.

*) Data in the present documentation may have become obsolete since printing.

13.4 Vor der Kontaktaufnahme... - Before contacting us...

Wir können Ihnen schnell und effizient helfen wenn Sie folgende Informationen bereithalten:

1. detaillierte Beschreibung der Störung und der Umstände.
2. Angaben auf dem Typenschild der betreffenden Produkte, insbesondere Typenschlüssel und Seriennummern.
3. Tel.-/Faxnummern und e-Mail-Adresse, unter denen Sie für Rückfragen zu erreichen sind.

For quick and efficient help, please have the following information ready:

1. Detailed description of the failure and circumstances.
2. Information on the type plate of the affected products, especially type codes and serial numbers.
3. Your phone/fax numbers and e-mail address, so we can contact you in case of questions.

13.5 Kundenbetreuungsstellen - Sales & Service Facilities

Deutschland – Germany

vom Ausland: (0) nach Landeskennziffer weglassen!
from abroad: don't dial (0) after country code!

Vertriebsgebiet Mitte Germany Centre Rexroth Indramat GmbH Bgm.-Dr.-Nebel-Str. 2 / Postf. 1357 97816 Lohr am Main / 97803 Lohr **Kompetenz-Zentrum Europa** Tel.: +49 (0)9352 40-0 Fax: +49 (0)9352 40-4885	**SERVICE AUTOMATION** **CALL ENTRY CENTER** **Helpdesk** **MO – FR** **von 07:00 - 18:00 Uhr** **from 7 am – 6 pm** **Tel. +49 (0) 9352 40 50 60** **Fax +49 (0) 9352 40 49 41** service.svc@boschrexroth.de	**SERVICE AUTOMATION** **HOTLINE 24 / 7 / 365** **außerhalb der Helpdesk-Zeit** **out of helpdesk hours** **Tel.: +49 (0)172 660 04 06** oder / or **Tel.: +49 (0)171 333 88 26**	**SERVICE AUTOMATION** **ERSATZTEILE / SPARES** verlängerte Ansprechzeit - extended office time - ♦ nur an Werktagen - only on working days - ♦ von 07:00 - 18:00 Uhr - from 7 am - 6 pm - **Tel. +49 (0) 9352 40 42 22**
Vertriebsgebiet Süd Germany South Bosch Rexroth AG Landshuter Allee 8-10 80637 München Tel.: +49 (0)89 127 14-0 Fax: +49 (0)89 127 14-490	Vertriebsgebiet West Germany West Bosch Rexroth AG Regionalzentrum West Borsigstrasse 15 40880 Ratingen Tel.: +49 (0)2102 409-0 Fax: +49 (0)2102 409-406 +49 (0)2102 409-430	Gebiet Südwest Germany South-West Bosch Rexroth AG Service-Regionalzentrum Süd-West Siemensstr. 1 70736 Fellbach Tel.: +49 (0)711 51046–0 Fax: +49 (0)711 51046–248	
Vertriebsgebiet Nord Germany North Bosch Rexroth AG Walsroder Str. 93 30853 Langenhagen Tel.: +49 (0) 511 72 66 57-0 Service: +49 (0) 511 72 66 57-256 Fax: +49 (0) 511 72 66 57-93 Service: +49 (0) 511 72 66 57-783	Vertriebsgebiet Mitte Germany Centre Bosch Rexroth AG Regionalzentrum Mitte Waldecker Straße 13 64546 Mörfelden-Walldorf Tel.: +49 (0) 61 05 702-3 Fax: +49 (0) 61 05 702-444	Vertriebsgebiet Ost Germany East Bosch Rexroth AG Beckerstraße 31 09120 Chemnitz Tel.: +49 (0)371 35 55-0 Fax: +49 (0)371 35 55-333	Vertriebsgebiet Ost Germany East Bosch Rexroth AG Regionalzentrum Ost Walter-Köhn-Str. 4d 04356 Leipzig Tel.: +49 (0)341 25 61-0 Fax: +49 (0)341 25 61-111

Europa (West) - Europe (West)

vom Ausland: (0) nach Landeskennziffer weglassen,
from abroad: don't dial (0) after country code,

Italien: 0 nach Landeskennziffer mitwählen
Italy: dial 0 after country code

Austria - Österreich	Austria – Österreich	Belgium - Belgien	Denmark - Dänemark
Bosch Rexroth GmbH Electric Drives & Controls Stachegasse 13 1120 Wien Tel.: +43 (0) 1 985 25 40 Fax: +43 (0) 1 985 25 40-93	Bosch Rexroth GmbH Electric Drives & Controls Industriepark 18 4061 Pasching Tel.: +43 (0)7221 605-0 Fax: +43 (0)7221 605-21	Bosch Rexroth NV/SA Henri Genessestraat 1 1070 Bruxelles Tel: +32 (0) 2 451 26 08 Fax: +32 (0) 2 451 27 90 info@boschrexroth.be service@boschrexroth.be	BEC A/S Zinkvej 6 8900 Randers Tel.: +45 87 11 90 60 Fax: +45 87 11 90 61
Great Britain – Großbritannien	Finland - Finnland	France - Frankreich	France - Frankreich
Bosch Rexroth Ltd. Electric Drives & Controls Broadway Lane, South Cerney Cirencester, Glos GL7 5UH Tel.: +44 (0)1285 863000 Fax: +44 (0)1285 863030 sales@boschrexroth.co.uk service@boschrexroth.co.uk	Bosch Rexroth Oy Electric Drives & Controls Ansatie 6 017 40 Vantaa Tel.: +358 (0)9 84 91-11 Fax: +358 (0)9 84 91-13 60	Bosch Rexroth SAS Electric Drives & Controls Avenue de la Trentaine (BP. 74) 77503 Chelles Cedex Tel.: +33 (0)164 72-63 22 Fax: +33 (0)164 72-63 20 **Hotline: +33 (0)608 33 43 28**	Bosch Rexroth SAS Electric Drives & Controls ZI de Thibaud, 20 bd. Thibaud (BP. 1751) 31084 Toulouse Tel.: +33 (0)5 61 43 61 87 Fax: +33 (0)5 61 43 94 12
France – Frankreich	Italy - Italien	Italy - Italien	Italy - Italien
Bosch Rexroth SAS Electric Drives & Controls 91, Bd. Irène Joliot-Curie 69634 Vénissieux – Cedex Tel.: +33 (0)4 78 78 53 65 Fax: +33 (0)4 78 78 53 62	Bosch Rexroth S.p.A. Via G. Di Vittorio, 1 20063 Cernusco S/N.MI **Hotline: +39 02 92 365 563** Tel.: +39 02 92 365 1 Service: +39 02 92 365 300 Fax: +39 02 92 365 500 Service: +39 02 92 365 516	Bosch Rexroth S.p.A. Via Paolo Veronesi, 250 10148 Torino Tel.: +39 011 224 88 11 Fax: +39 011 224 88 30	Bosch Rexroth S.p.A. Via Mascia, 1 80053 Castellamare di Stabia NA Tel.: +39 081 8 71 57 00 Fax: +39 081 8 71 68 85
Italy - Italien	Italy - Italien	Netherlands - Niederlande/Holland	Netherlands – Niederlande/Holland
Bosch Rexroth S.p.A. Via del Progresso, 16 (Zona Ind.) 35020 Padova Tel.: +39 049 8 70 13 70 Fax: +39 049 8 70 13 77	Bosch Rexroth S.p.A. Via Isonzo, 61 40033 Casalecchio di Reno (Bo) Tel.: +39 051 29 86 430 Fax: +39 051 29 86 490	Bosch Rexroth Services B.V. Technical Services Kruisbroeksestraat 1 (P.O. Box 32) 5281 RV Boxtel Tel.: +31 (0) 411 65 19 51 Fax: +31 (0) 411 67 78 14 **Hotline: +31 (0) 411 65 19 51** services@boschrexroth.nl	Bosch Rexroth B.V. Kruisbroeksestraat 1 (P.O. Box 32) 5281 RV Boxtel Tel.: +31 (0) 411 65 16 40 Fax: +31 (0) 411 65 14 83 www.boschrexroth.nl
Norway - Norwegen	Spain – Spanien	Spain - Spanien	Spain - Spanien
Bosch Rexroth AS Electric Drives & Controls Berghagan 1 or: Box 3007 1405 Ski-Langhus 1402 Ski Tel.: +47 64 86 41 00 Fax: +47 64 86 90 62 **Hotline: +47 64 86 94 82** jul.ruud@rexroth.no	Goimendi Automation Parque Empresarial Zuatzu C/ Francisco Grandmontagne no.2 20018 San Sebastian Tel.: +34 9 43 31 84 21 - service: +34 9 43 31 84 56 Fax: +34 9 43 31 84 27 - service: +34 9 43 31 84 60 sat.indramat@goimendi.es	Bosch Rexroth S.A. Electric Drives & Controls Centro Industrial Santiga Obradors s/n 08130 Santa Perpetua de Mogoda Barcelona Tel.: +34 9 37 47 94 00 Fax: +34 9 37 47 94 01	Bosch Rexroth S.A. Electric Drives & Controls c/ Almazara, 9 28760 Tres Cantos (Madrid) Tel.: +34 91 806 24 79 Fax: +34 91 806 24 72 fernando.bariego@boschrexroth.es
Sweden - Schweden	Sweden - Schweden	Switzerland East - Schweiz Ost	Switzerland West - Schweiz West
Bosch Rexroth AB Electric Drives & Controls - Varuvägen 7 (Service: Konsumentvägen 4, Älfsjö) 125 81 Stockholm Tel.: +46 (0) 8 727 92 00 Fax: +46 (0) 8 647 32 77	Bosch Rexroth AB Electric Drives & Controls Ekvändan 7 254 67 Helsingborg Tel.: +46 (0) 4 238 88 -50 Fax: +46 (0) 4 238 88 -74	Bosch Rexroth Schweiz AG Electric Drives & Controls Hemrietstrasse 2 8863 Buttikon Tel. +41 (0) 55 46 46 111 Fax +41 (0) 55 46 46 222	Bosch Rexroth Suisse SA Av. Général Guisan 26 1800 Vevey 1 Tel.: +41 (0)21 632 84 20 Fax: +41 (0)21 632 84 21

Europa (Ost) - Europe (East)

vom Ausland: (0) nach Landeskennziffer weglassen
from abroad: don't dial (0) after country code

Czech Republic - Tschechien	Czech Republic - Tschechien	Hungary - Ungarn	Poland – Polen
Bosch -Rexroth, spol.s.r.o. Hviezdoslavova 5 627 00 Brno Tel.: +420 (0)5 48 126 358 Fax: +420 (0)5 48 126 112	DEL a.s. Strojírenská 38 591 01 Zdar nad Sázavou Tel.: +420 566 64 3144 Fax: +420 566 62 1657	Bosch Rexroth Kft. Angol utca 34 1149 Budapest Tel.: +36 (1) 422 3200 Fax: +36 (1) 422 3201	Bosch Rexroth Sp.zo.o. ul. Staszica 1 05-800 Pruszków Tel.: +48 (0) 22 738 18 00 – service: +48 (0) 22 738 18 46 Fax: +48 (0) 22 758 87 35 – service: +48 (0) 22 738 18 42
Poland – Polen	**Romania - Rumänien**	**Romania - Rumänien**	**Russia - Russland**
Bosch Rexroth Sp.zo.o. Biuro Poznan ul. Dabrowskiego 81/85 60-529 Poznan Tel.: +48 061 847 64 62 /-63 Fax: +48 061 847 64 02	East Electric S.R.L. Bdul Basarabia no.250, sector 3 73429 Bucuresti Tel./Fax:: +40 (0)21 255 35 07 +40 (0)21 255 77 13 Fax: +40 (0)21 725 61 21 eastel@rdsnet.ro	Bosch Rexroth Sp.zo.o. Str. Drobety nr. 4-10, app. 14 70258 Bucuresti, Sector 2 Tel.: +40 (0)1 210 48 25 +40 (0)1 210 29 50 Fax: +40 (0)1 210 29 52	Bosch Rexroth OOO Wjatskaja ul. 27/15 127015 Moskau Tel.: +7-095-785 74 78 +7-095 785 74 79 Fax: +7 095 785 74 77 laura.kanina@boschrexroth.ru
Russia Belarus - Weissrussland	**Turkey - Türkei**	**Turkey - Türkei**	**Slowenia - Slowenien**
ELMIS 10, Internationalnaya 246640 Gomel, Belarus Tel.: +375/ 232 53 42 70 +375/ 232 53 21 69 Fax: +375/ 232 53 37 69 elmis_ltd@yahoo.com	Bosch Rexroth Otomasyon San & Tic. A..S. Fevzi Cakmak Cad No. 3 34630 Sefaköy Istanbul Tel.: +90 212 413 34 00 Fax: +90 212 413 34 17 www.boschrexroth.com.tr	Servo Kontrol Ltd. Sti. Perpa Ticaret Merkezi B Blok Kat: 11 No: 1609 80270 Okmeydani-Istanbul Tel: +90 212 320 30 80 Fax: +90 212 320 30 81 remzi.sali@servokontrol.com www.servokontrol.com	DOMEL Otoki 21 64 228 Zelezniki Tel.: +386 5 5117 152 Fax: +386 5 5117 225 brane.ozebek@domel.si

Africa, Asia, Australia – incl. Pacific Rim

Australia - Australien AIMS - Australian Industrial Machinery Services Pty. Ltd. 28 Westside Drive Laverton North Vic 3026 Melbourne Tel.: +61 3 93 14 3321 Fax: +61 3 93 14 3329 **Hotlines: +61 3 93 14 3321** **+61 4 19 369 195** enquires@aimservices.com.au	Australia - Australien Bosch Rexroth Pty. Ltd. No. 7, Endeavour Way Braeside Victoria, 31 95 Melbourne Tel.: +61 3 95 80 39 33 Fax: +61 3 95 80 17 33 mel@rexroth.com.au	China Shanghai Bosch Rexroth Hydraulics & Automation Ltd. Waigaoqiao, Free Trade Zone No.122, Fu Te Dong Yi Road Shanghai 200131 - P.R.China Tel.: +86 21 58 66 30 30 Fax: +86 21 58 66 55 23 richard.yang_sh@boschrexroth.com.cn gf.zhu_sh@boschrexroth.com.cn	China Shanghai Bosch Rexroth Hydraulics & Automation Ltd. 4/f, Marine Tower No.1, Pudong Avenue Shanghai 200120 - P.R.China Tel: +86 21 68 86 15 88 Fax: +86 21 58 40 65 77
China Bosch Rexroth China Ltd. 15/F China World Trade Center 1, Jianguomenwai Avenue Beijing 100004, P.R.China Tel.: +86 10 65 05 03 80 Fax: +86 10 65 05 03 79	China Bosch Rexroth China Ltd. Guangzhou Repres. Office Room 1014-1016, Metro Plaza, Tian He District, 183 Tian He Bei Rd Guangzhou 510075, P.R.China Tel.: +86 20 8755-0030 +86 20 8755-0011 Fax: +86 20 8755-2387	China Bosch Rexroth (China) Ltd. A-5F., 123 Lian Shan Street Sha He Kou District Dalian 116 023, P.R.China Tel.: +86 411 46 78 930 Fax: +86 411 46 78 932	China Melchers GmbH BRC-SE, Tightening & Press-fit 13 Floor Est Ocean Centre No.588 Yanan Rd. East 65 Yanan Rd. West Shanghai 200001 Tel.: +86 21 6352 8848 Fax: +86 21 6351 3138
Hongkong Bosch Rexroth (China) Ltd. 6th Floor, Yeung Yiu Chung No.6 Ind Bldg. 19 Cheung Shun Street Cheung Sha Wan, Kowloon, Hongkong Tel.: +852 22 62 51 00 Fax: +852 27 41 33 44 alexis.siu@boschrexroth.com.hk	India - Indien Bosch Rexroth (India) Ltd. Electric Drives & Controls Plot. No.96, Phase III Peenya Industrial Area Bangalore – 560058 Tel.: +91 80 51 17 0-211...-218 Fax: +91 80 83 94 345 +91 80 83 97 374 mohanvelu.t@boschrexroth.co.in	India - Indien Bosch Rexroth (India) Ltd. Electric Drives & Controls Advance House, II Floor Ark Industrial Compound Narol Naka, Makwana Road Andheri (East), Mumbai - 400 059 Tel.: +91 22 28 56 32 90 +91 22 28 56 33 18 Fax: +91 22 28 56 32 93 singh.op@boschrexroth.co.in	India - Indien Bosch Rexroth (India) Ltd. S-10, Green Park Extension New Delhi – 110016 Tel.: +91 11 26 56 65 25 +91 11 26 56 65 27 Fax: +91 11 26 56 68 87 koul.rp@boschrexroth.co.in
Indonesia - Indonesien PT. Bosch Rexroth Building # 202, Cilandak Commercial Estate Jl. Cilandak KKO, Jakarta 12560 Tel.: +62 21 7891169 (5 lines) Fax: +62 21 7891170 - 71 rudy.karimun@boschrexroth.co.id	Japan Bosch Rexroth Automation Corp. Service Center Japan Yutakagaoka 1810, Meito-ku, NAGOYA 465-0035, Japan Tel.: +81 52 777 88 41 +81 52 777 88 53 +81 52 777 88 79 Fax: +81 52 777 89 01	Japan Bosch Rexroth Automation Corp. Electric Drives & Controls 2F, I.R. Building Nakamachidai 4-26-44, Tsuzuki-ku YOKOHAMA 224-0041, Japan Tel.: +81 45 942 72 10 Fax: +81 45 942 03 41	Korea Bosch Rexroth-Korea Ltd. Electric Drives and Controls Bongwoo Bldg. 7FL, 31-7, 1Ga Jangchoong-dong, Jung-gu Seoul, 100-391 Tel.: +82 234 061 813 Fax: +82 222 641 295
Korea Bosch Rexroth-Korea Ltd. 1515-14 Dadae-Dong, Saha-gu Electric Drives & Controls Pusan Metropolitan City, 604-050 Tel.: +82 51 26 00 741 Fax: +82 51 26 00 747 eunkyong.kim@boschrexroth.co.kr	Malaysia Bosch Rexroth Sdn.Bhd. 11, Jalan U8/82, Seksyen U8 40150 Shah Alam Selangor, Malaysia Tel.: +60 3 78 44 80 00 Fax: +60 3 78 45 48 00 hhlim@boschrexroth.com.my rexroth1@tm.net.my	Singapore - Singapur Bosch Rexroth Pte Ltd 15D Tuas Road Singapore 638520 Tel.: +65 68 61 87 33 Fax: +65 68 61 18 25 sanjay.nemade @boschrexroth.com.sg	South Africa - Südafrika TECTRA Automation (Pty) Ltd. 100 Newton Road, Meadowdale Edenvale 1609 Tel.: +27 11 971 94 00 Fax: +27 11 971 94 40 **Hotline: +27 82 903 29 23** georgv@tectra.co.za
Taiwan Bosch Rexroth Co., Ltd. Taichung Industrial Area No.19, 38 Road Taichung, Taiwan 407, R.O.C. Tel : +886 - 4 -235 08 383 Fax: +886 - 4 -235 08 586 jim.lin@boschrexroth.com.tw david.lai@boschrexroth.com.tw	Taiwan Bosch Rexroth Co., Ltd. Tainan Branch No. 17, Alley 24, Lane 737 Chung Cheng N.Rd. Yungkang Tainan Hsien, Taiwan, R.O.C. Tel : +886 - 6 –253 6565 Fax: +886 - 6 –253 4754 charlie.chen@boschrexroth.com.tw	Thailand NC Advance Technology Co. Ltd. 59/76 Moo 9 Ramintra road 34 Tharang, Bangkhen, Bangkok 10230 Tel.: +66 2 943 70 62 +66 2 943 71 21 Fax: +66 2 509 23 62 Hotline +66 1 984 61 52 sonkawin@hotmail.com	

Rexroth
Bosch Group

Nordamerika – North America

USA Headquarters - Hauptniederlassung Bosch Rexroth Corporation Electric Drives & Controls 5150 Prairie Stone Parkway Hoffman Estates, IL 60192-3707 Tel.: +1 847 645-3600 Fax: +1 847 645-6201 servicebrc@boschrexroth-us.com repairbrc@boschrexroth-us.com	USA Central Region - Mitte Bosch Rexroth Corporation Electric Drives & Controls 1701 Harmon Road Auburn Hills, MI 48326 Tel.: +1 248 393-3330 Fax: +1 248 393-2906	USA Southeast Region - Südost Bosch Rexroth Corporation Electric Drives & Controls 2810 Premiere Parkway, Suite 500 Duluth, GA 30097 Tel.: +1 678 957-4050 Fax: +1 678 417-6637	**USA SERVICE-HOTLINE** - 7 days x 24hrs - **+1-800-REXROTH** **+1 800 739-7684**
USA Northeast Region – Nordost Bosch Rexroth Corporation Electric Drives & Controls 99 Rainbow Road East Granby, CT 06026 Tel.: +1 860 844-8377 Fax: +1 860 844-8595	USA West Region – West Bosch Rexroth Corporation Electric Drives & Controls 7901 Stoneridge Drive, Suite 220 Pleasanton, CA 94588 Tel.: +1 925 227-1084 Fax: +1 925 227-1081		
Canada East - Kanada Ost Bosch Rexroth Canada Corporation Burlington Division 3426 Mainway Drive Burlington, Ontario Canada L7M 1A8 Tel.: +1 905 335 5511 Fax: +1 905 335 4184 michael.moro@boschrexroth.ca	Canada West - Kanada West Bosch Rexroth Canada Corporation 5345 Goring St. Burnaby, British Columbia Canada V7J 1R1 Tel. +1 604 205 5777 Fax +1 604 205 6944 david.gunby@boschrexroth.ca	Mexico Bosch Rexroth Mexico S.A. de C.V. Calle Neptuno 72 Unidad Ind. Vallejo 07700 Mexico, D.F. Tel.: +52 55 57 54 17 11 Fax: +52 55 57 54 50 73 mario.francioli@boschrexroth.com.mx	Mexico Bosch Rexroth S.A. de C.V. Calle Argentina No 3913 Fracc. las Torres 64930 Monterrey, N.L. Tel.: +52 81 83 65 22 53 +52 81 83 65 89 11 +52 81 83 49 80 91 Fax: +52 81 83 65 52 80

Südamerika – South America

Argentina - Argentinien Bosch Rexroth S.A.I.C. "The Drive & Control Company" Rosario 2302 B1606DLD Carapachay Provincia de Buenos Aires Tel.: +54 11 4756 01 40 +54 11 4756 02 40 +54 11 4756 03 40 +54 11 4756 04 40 Fax: +54 11 4756 01 36 +54 11 4721 91 53 victor.jabif@boschrexroth.com.ar	Argentina - Argentinien NAKASE Servicio Tecnico CNC Calle 49, No. 5764/66 B1653AOX Villa Balester Provincia de Buenos Aires Tel.: +54 11 4768 36 43 Fax: +54 11 4768 24 13 **Hotline: +54 11 155 307 6781** nakase@usa.net nakase@nakase.com gerencia@nakase.com (Service)	Brazil - Brasilien Bosch Rexroth Ltda. Av. Tégula, 888 Ponte Alta, Atibaia SP CEP 12942-440 Tel.: +55 11 4414 56 92 +55 11 4414 56 84 Fax sales: +55 11 4414 57 07 Fax serv.: +55 11 4414 56 86 alexandre.wittwer@rexroth.com.br	Brazil - Brasilien Bosch Rexroth Ltda. R. Dr.Humberto Pinheiro Vieira, 100 Distrito Industrial [Caixa Postal 1273] 89220-390 Joinville - SC Tel./Fax: +55 47 473 58 33 Mobil: +55 47 9974 6645 prochnow@zaz.com.br
Columbia - Kolumbien Reflutec de Colombia Ltda. Calle 37 No. 22-31 Santafé de Bogotá, D.C. Colombia Tel.: +57 1 368 82 67 +57 1 368 02 59 Fax: +57 1 268 97 37 reflutec@etb.net.co			

14 Index

A

B

C

D

E

F

H

I

Rexroth
Bosch Group

Rexroth
Bosch Group

Bosch Rexroth AG
Electric Drives and Controls
P.O. Box 13 57
97803 Lohr, Germany
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr, Germany
Phone +49 (0)93 52-40-50 60
Fax +49 (0)93 52-40-49 41
service.svc@boschrexroth.de
www.boschrexroth.com

R911297895

Printed in Germany
DOK-MOTOR*-MBS-H******-PR02-EN-P